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Scientific and Technical Aerospace Reports

A Semi-monthly Abstract Journal with Indexes

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VOLUME 1 NUMBER 12

N63-15245—N63-15762

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Scientific and Technical Aerospace Reports (STAR) is a comprehensive abstracting and indexing service devoted to report literature bearing on the science and technology of aeronautics and space. Published twice each month, commencing in 1963, *STAR* is the successor to *Technical Publications Announcements* and provides coverage of:

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(3) scientific and technical articles prepared by NASA and contractor authors which appear in learned and technical journals.

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STAR is arranged in two major sections. The first contains complete bibliographic citations with informative abstracts, arranged by appropriate subject categories to facilitate scanning. The second section comprises five indexes: Subject, Corporate Source, Personal Author, Report Number, and Accession Number. Separate cumulative indexes are published quarterly, semiannually, and annually.

Each abstract is prefixed by the NASA accession number, and the separate indexes contain explanatory notes which guide the user to the desired abstract.

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Office of Scientific and Technical Information

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, December 20, 1962

Table of Contents

Volume 1 Number 12 June 23, 1963

Abstracts in the journal are grouped under the following categories:

PAGE

01 GENERAL 787

Includes: management; space law and legal matters; symposia or conferences of a broad or a general nature.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW 789

Includes: aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc.

For related information see: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES 790

Includes: ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics

04 AIRCRAFT 791

Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

05 ASTRONOMY AND ASTROPHYSICS 791

Includes: celestial mechanics; and radioastronomy.

For related information see: 12 Geophysics; and 29 Space Sciences.

06 AUXILIARY SYSTEMS 792

Includes: fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuatprs; and inverters.

For primary propulsion systems see: 27 Propulsion.

For related information see: 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; and 22 Navigation and Guidance.

07 CHEMISTRY 793

Includes: chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis.

For related information see: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

08 COMMUNICATIONS 797

Includes: communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation.

For tracking stations see: 10 Facilities.

For related information see: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation; and 22 Navigation and Guidance.

09 ELECTRONICS 799

Includes: circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory.

For related information see: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation; 22 Navigation and Guidance; and 25 Physics, Solid-State.

10 FACILITIES 803

Includes: airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations.

For related information see: 06 Auxiliary Systems.

11 FLUID MECHANICS 807

Includes: boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; 13 Heat Transfer; and 24 Physics, Plasma.

12 GEOPHYSICS 812

Includes: auroral phenomena; upper atmospheric studies; cartography; geodesy; and geomagnetism.

For Van Allen belts see: 28 Space Radiation.

For related information see: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

13 HEAT TRANSFER 813

Includes: ablation; cooling; heating; and other thermal effects.

For aerothermodynamics see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings and Control Surfaces.

For combustion see: 26 Propellants and Combustion.

For related information see: 11 Fluid Mechanics.

14 HUMAN BEHAVIOR 814

Includes: crew training and evaluation; piloting; psychological factors.

For simulators see: 10 Facilities.

For related information see: 16 Life Sciences.

15 INSTRUMENTATION 815

Includes: design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; and sensors and transducers.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

16 LIFE SCIENCES 818

Includes: biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness.

For related information see: 14 Human Behavior; and 28 Space Radiation.

17 MACHINE ELEMENTS AND PROCESSES 821

Includes: bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; and materials fabrication, handling, and inspection.

For related information see: 06 Auxiliary Systems.

18 MATERIALS, METALLIC 823

Includes: cermets; mechanical and physical properties of alloys and metals; and metallurgy.

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

19 MATERIALS, NONMETALLIC 831

Includes: mechanical and physical properties of nonmetals (e.g., plastics).

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

20 MATHEMATICS 833

Includes: calculation methods and theory; computers; data processing; and numerical analysis.

For related information see: 08 Communications; 09 Electronics; 10 Facilities; and 22 Navigation and Guidance.

TABLE OF CONTENTS

21 METEOROLOGY 837

Includes: climatology; weather forecasting; lower atmosphere studies; and oceanography.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

22 NAVIGATION AND GUIDANCE 838

Includes: autopilots; star tracking; inertial platforms; and traffic control.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; 20 Mathematics; and 29 Space Sciences.

23 PHYSICS, GENERAL 838

Includes: acoustics; cryogenics; optics; and thermodynamics.

For astrophysics see: 05 Astronomy and Astrophysics.

For related information see: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

24 PHYSICS, PLASMA 842

Includes: fusion; and magnetohydrodynamics.

For related information see: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

25 PHYSICS, SOLID-STATE 845

Includes: semiconductor theory; and masers.

For related information see: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

26 PROPELLANTS AND COMBUSTION 847

Includes: fuels; igniters; and oxidizers.

For related information see: 07 Chemistry; and 27 Propulsion.

27 PROPULSION 853

Includes: airbreathing, electric, liquid, nuclear, and solid propulsion.

For related information see: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

28 SPACE RADIATION 854

Includes: cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts.

For related information see: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

29 SPACE SCIENCES 856

Includes: space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories.

For space biology see: 16 Life Sciences.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

30 SPACE VEHICLES 859

Includes: launch vehicle - spacecraft combinations; operating problems; and stability and control.

For manned space capsules, satellites, and space probes see: 32 Space Vehicles (Spacecraft).

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

31 SPACE VEHICLES (LAUNCH VEHICLES) 860

Includes: boosters; clustered rockets; and multistage rockets.

For propulsion engines see: 27 Propulsion.

For manned space capsules, satellites, and space probes see: 32 Space Vehicles (Spacecraft).

For launch vehicle - spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

32 SPACE VEHICLES (SPACECRAFT) 861

Includes: manned space capsules; satellites; and space probes.

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For launch vehicle - spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

33 STRESSES AND LOADS 863

Includes: fatigue; vibration; flutter; and structural tests.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 34 Structural Design.

34 STRUCTURAL DESIGN 865

Includes: structural elements; and weight analysis.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 33 Stresses and Loads.

★ **SUBJECT INDEX I-1**

★ **CORPORATE SOURCE INDEX I-55**

★ **PERSONAL AUTHOR INDEX I-71**

★ **REPORT NUMBER INDEX I-97**

★ **ACCESSION NUMBER INDEX I-103**

VOLUME 1 NUMBER 12

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

June 23, 1963

01 GENERAL

Includes: management; space law and legal matters; symposia or conferences of a broad or a general nature.

N63-15342 Avco Corp. Research and Advanced Development Div., Wilmington, Mass.

THE EQUIVALENT SYSTEM TECHNIQUE FOR RELIABILITY DEMONSTRATION

Donald J. Kerins [1962] 20 p 1 ref

An equivalent systems technique for evaluating the reliability of the one-shot type of military weapons systems is described. This technique combines reliability data from the maximum number of sources (component, subsystem, system, flight tests of the operational configuration, etc.) with increasing levels of complexity. Advantages of this approach include: (1) minimum costs consistent with technical accuracy; (2) elimination of the necessity of establishing confidence levels at the individual component level; and (3) evaluation of design changes at the component level, so that the only changes required in the previous reliability estimate are those involving the items in which such changes did occur. M.P.G.

N63-15350 Virginia U. School of Engineering and Applied Science, Charlottesville, Va.

PROJECT SQUID Semi-Annual Progress Report, 1 Oct. 1962 to 31 Mar. 1963

Apr. 1, 1963 81 p refs

(Contract Nonr-3623(00))

CONTENTS:

I. FLUID MECHANICS

1. FUNDAMENTAL INVESTIGATION OF NONSTEADY AND NONEQUILIBRIUM FLOW G. Rudinger (Cornell Aeronautical Lab., Inc.) p 1–5 4 refs
2. INVESTIGATION OF TURBULENCE Leslie S. G. Kovasznay (Johns Hopkins U.) p 6–9 3 refs

II. TRANSPORT AND TRANSFER PROCESSES

3. FUNDAMENTAL STUDY OF DYNAMICS OF GASES AND PLASMAS G. Sandri, R. D. Sullivan, T. F. Morse, and E. A. Frieman (Aeronautical Res. Associates of Princeton, Inc.) p 10–12 11 refs
4. RESEARCH ON THERMODYNAMIC AND TRANSPORT PROPERTIES OF GASES AT HIGH TEMPERATURES AND PRESSURES J. Kestin and J. Ross et al (Brown U.) p 13–17
5. PROPERTIES OF TWO-PHASE FLOW—ELECTRIC PHENOMENA S. L. Soo, J. A. Hultberg, G. J. Trezek, and R. C. Dimick (Illinois U.) p 18–22 6 refs
6. THERMAL CONDUCTIVITY OF GASES AND LIQUIDS OVER A RANGE OF TEMPERATURES AND PRESSURES F. G. Keyes (Massachusetts Inst. of Tech.) p 23–24
7. A STUDY OF FLUID WITH SUSPENDED PARTICLES R. Eichorn, J. F. Muir, and R. A. Shanny (Princeton U.) p 25–26 2 refs

III. CHEMICAL KINETICS

8. THEORY OF FAST REACTIONS M. Boudart (California U., Berkeley) p 27–29 2 refs
9. KINETICS OF ELEMENTARY REACTIONS B. B. Darwent and A. L. Flores (Catholic U.) p 30–31
10. INVESTIGATION OF REACTION KINETICS IN HIGH-TEMPERATURE GASES G. H. Markstein (Cornell Aeronautical Lab., Inc.) p 32–36 4 refs
11. REACTIONS OF IONS AND ELECTRONICALLY EXCITED SPECIES WITH ATOMS AND MOLECULES IN THE GAS PHASE J. L. Franklin, F. H. Field, and M. S. B. Munson (Humble Oil and Refining Co.) p 37–42 5 refs
12. HIGH TEMPERATURE REACTIONS H. B. Palmer, B. E. Knox, R. Carabetta, and E. T. Mc Hale (Pennsylvania State U.) p 43–45 3 refs
13. CHEMICAL KINETICS AND GAS DYNAMICS OF ATOM AND FREE-RADICAL REACTIONS H. Wise, C. M. Ablow, C. R. Gatz, D. J. Schott, and B. J. Wood (Stanford Res. Inst.) p 46–51 13 refs
14. INELASTIC MOLECULAR COLLISIONS J. E. Scott, Jr., D. G. Griffith, J. H. Heald, and J. A. Phipps (Virginia U.) p 52–57 6 refs

IV. COMBUSTION PHENOMENA

15. SOLID-PROPELLANT FLAME MECHANISMS R. Friedman, A. Macek, and J. M. Semple (Atlantic Research Corp.) p 58–61 2 refs
16. THERMAL CONDUCTIVITIES OF GASES AT HIGH TEMPERATURES J. R. Ferron, B. J. Kraus, and J. R. Balder (Delaware U.) p 62–64 3 refs
17. MAGNETOHYDRODYNAMICS OF PARTIALLY IONIZED GASES J. A. Fay, W. C. Moffatt, R. L. Leonard, M. Sajben, and J. B. Workman (Massachusetts Inst. of Tech.) p 65–67
18. ENTHALPY FLUCTUATIONS IN PLASMA JETS P. L. Blackshear, Jr., W. H. Kuretsky, G. O. Voss, D. Y. Cheng, and F. D. Dorman (Minnesota U.) p 68–71 1 ref

N63-15357 National Aeronautics and Space Administration, Washington, D.C.

PROCEEDINGS OF THE SECOND NASA-INDUSTRY PROGRAM PLANS CONFERENCE, WASHINGTON, D.C., FEBRUARY 11-12, 1963

Walter L. Lingle, Jr., et al [1963] 221 p

(NASA SP-29) GPO: $1.25

The papers presented at this conference discuss the NASA projects currently in progress and studies being made of possible new projects. The purpose of these papers is to acquaint industry with these projects and provide information that will be of benefit to industry in planning research and development programs and in responding to future NASA requests for proposals. R.C.M.

N63-15370 Aberdeen Proving Ground. Ballistic Research Lab., Md.

HEAT TRANSFER, BARREL TEMPERATURES AND THERMAL STRAINS IN GUNS

Ernest L. Bannister, Richard N. Jones, and Donald W. Bagwell Feb. 1963 55 p 2 refs
(BRL-1192)

Data on temperature distribution and heat input in a 37-mm gun during firing are presented. These results are discussed and compared with theoretical values obtained by using the Nordheim, Soodak and Nordheim method of calculation. Author

N63-15434 Congress. Senate. Committee on Foreign Relations

COMMUNICATIONS SATELLITE ACT OF 1962: AN ACT FOR THE ESTABLISHMENT, OWNERSHIP, OPERATION, AND REGULATION OF A COMMERCIAL COMMUNICATIONS SATELLITE SYSTEM, AND FOR OTHER PURPOSES Hearings before the Committee on Foreign Relations, U.S. Senate, Aug. 3, 6, 7, 8, and 9, 1962

J. W. Fulbright Washington, GPO, 1962 458 p
(87th Cong. 2nd Sess. H.R. 11040 Committee Print)

Hearings on the international relations aspects and the international legal aspects of the Communications Satellite Act of 1962, held before the Committee on Foreign Relations of the U.S. Senate, are presented. M.P.G.

N63-15458 Federal Aviation Agency, Washington, D.C.

FEDERAL AVIATION AGENCY AIRSPACE CLOSURE. PROJECT SEDAN Preliminary and Final Report

Stuart Halsey Apr. 17, 1963 13 p 27 refs AEC Plowshare Program (PNE-205F) OTS: $0.50

To ensure airspace users' safety during the nuclear cratering detonation-Project Sedan, all pilots who were contemplating flight within the pertinent area on July 6, 1962, were requested to contact the FAA for routing changes. The major airway affected by this closure was a transcontinental route serving San Francisco and Denver. J.A.J.

N63-15626 Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio

PROCEEDINGS OF THE OPTIMUM SYSTEM SYNTHESIS CONFERENCE, 11-13 SEPTEMBER 1962

Feb. 1963 396 p 212 refs
(ASD-TDR-63-119)

CONTENTS:

1. FEEDBACK DESIGN AND OPTIMAL CONTROL THEORY J. G. Truxal and P. Dorato (Polytechnic Inst. of Brooklyn) p 1–9 12 refs (See N63-15627 12-09)
2. FUNCTION SPACE METHODS IN CONTROL SYSTEMS OPTIMIZATION A. V. Balakrishnan and H. C. Hsieh (Calif. U., Los Angeles) p 10–40 6 refs (See N63-15628 12-09)
3. THE PROBLEM OF OPTIMAL MODE SWITCHING R. A. Nesbit (Calif. U., Los Angeles and Aerospace Corp., El Segundo) p 41–54 20 refs (See N63-15629 12-09)
4. OPTIMAL THRUST PROGRAMMING FOR MINIMAL FUEL MIDCOURSE GUIDANCE J. S. Meditch (Aerospace Corp., El Segundo) p 55–68 10 refs (See N63-15630 12-29)
5. THE SYNTHESIS OF OPTIMAL CONTROLLERS B. H. Paiewonsky (Aeron. Res. Associates of Princeton, Inc.) p 69–97 62 refs (See N63-15631 12-09)
6. APPLICATIONS OF OPTIMIZATION THEORY. SECTION I—AN APPLICATION OF TIME-OPTICAL CONTROL THEORY TO LAUNCH VEHICLE REGULATION F. B. Smith, Jr. (Minneapolis-Honeywell Reg. Co.) and J. A. Lovingood (NASA. Marshall Space Flight Center) p 99–118 9 refs (See N63-15632 12-09)
7. APPLICATIONS OF OPTIMIZATION THEORY. SECTION II—THE EQUIVALENT MINIMIZATION PROBLEM AND THE NEWTON-RAPHSON OPTIMIZATION METHOD D. K. Scharmack (Minneapolis-Honeywell Reg. Co.) p 119–158 9 refs (See N63-15633 12-20)
8. APPLICATION OF OPTIMAL LINEAR CONTROL THEORY TO THE DESIGN OF AEROSPACE VEHICLE CONTROL SYSTEMS P. A. Reynolds and E. G. Rynaski (Cornell Aeron. Lab., Inc.) p 159–188 4 refs (See N63-15634 12-09)
9. SORTIE BOOST AND GLIDE TRAJECTORIES DETERMINED FOR SPECIFIED MISSION REQUIREMENTS BY THE STEEPEST-ASCENT TECHNIQUE K. Mikami, C. T. Battle, R. S. Goddell, and A. E. Bryson (Raytheon Co.) p 189–239 12 refs (See N63-15635 12-30)
10. THE DOLIAC MACRO-MICRO CONTROL LOGIC, ITS SYNTHESIS, EVALUATION, POTENTIAL AND PROBLEMS D. O. Dommasch (DODCO, Inc.) p 241–267 11 refs (See N63-15636 12-09)
11. THE APPROXIMATE REALIZATION OF OPTIMUM CONTROL SYSTEMS S. S. L. Chang and F. J. Alexandro, Jr. (New York U.) p 269–322 8 refs (See N63-15637 12-09)
12. APPLICATIONS AND APPLICABILITY OF OPTIMUM NONLINEAR CONTROL R. Oldenburger (Purdue U.) p 323–341 10 refs (See N63-15638 12-09)
13. OPTIMAL PROGRAMMING OF MULTIVARIABLE CONTROL SYSTEMS IN THE PRESENCE OF NOISE A. E. Bryson, Jr. (Harvard U.) p 343–351 16 refs (See N63-15639 12-20)
14. SMOOTHING FOR LINEAR AND NONLINEAR DYNAMIC SYSTEMS A. E. Bryson (Harvard U.) and M. Frazier (Raytheon Co.) p 353–364 2 refs (See N63-15640 12-20)
15. FIRST ORDER IMPLICATIONS OF THE CALCULUS OF VARIATIONS IN GUIDANCE AND CONTROL R. F. Kalman (RIAS) p 365–371 5 refs (See N63-15641 12-20)
16. A SYNTHESIS METHOD FOR OPTIMAL CONTROLS L. W. Neustadt (Aerospace Corp.) p 373–381 12 refs (See N63-15642 12-20)
17. ON OPTIMAL CONTROL FOR SYSTEMS WITH NUMERATOR DYNAMICS C. A. Harvey, E. B. Lee (Minneapolis-Honeywell Reg. Co.), and L. Markus (Minn. U.) p 383-395 4 refs (See N63-15643 12-20)

N63-15654 California U., Livermore, Lawrence Radiation Lab.

HIGH-PRESSURE EQUATION OF STATE. BIBLIOGRAPHY AND INDEX (1925–1962)

Stephen G. Brush, Rose Kraft and Jean Senkin Jan. 22, 1963 315 p 1425 refs
(Contract W-7405-eng-48)
(UCRL-7160) OTS: $4.00

The bibliography lists about 1500 references on the equation-of-state of materials at high pressure. These are listed chronologically; each citation is accompanied by descriptors listing the materials or theories investigated. The indexing is more complete for elements, inorganic compounds, minerals, and explosives than for organic compounds and composite materials. Most mixtures have been excluded. For gases, "high pressure" is taken to mean pressures above 50 atm, or virial coefficients higher than the second; but not for liquids and solids, all compressibility measurements are included when found. Topics such as shock-wave compression, melting curves, quantum theory of the electron gas, and Thomas-Fermi theory have also been included. Author

N63-15670 Advisory Group for Aeronautical Research and Development, Paris (France)

DISCUSSIONS FOLLOWING THE PRESENTATION OF PAPERS ON PRESSURE MEASUREMENT

Mar. 1958 63 p Pressure-Measurements Meetings of the AGARD Wind Tunnel and Model Testing Panel, London, Mar. 24–28, 1958 (AGARD 163-177)

The discussions presented deal with wind tunnel pressure measurements. These papers cover pressure measuring systems and devices for use in low-speed, blow-down, supersonic, propulsion, and arc discharge wind tunnels. Other areas covered include wind tunnel pressure measurements from the operator's point of view, low-pressure measuring problems, and pressure measurement in armament research. R.C.M.

N63-15708 Atomic Energy Commission. Div. of Plans and Reports, Washington, D.C.

FUNDAMENTAL NUCLEAR ENERGY RESEARCH–[1962] Third Annual Special Report of the Atomic Energy Commission

Dec. 1962 430 p refs

GPO: $2.50

A review of fundamental nuclear research in the following fields is presented: (1) the medical and life sciences, (2) the physical sciences, (3) nuclear reactor development, (4) radiation in the environment, and (5) the treatment and disposal of radioactive wastes. I.v.L.

N63-15733 RAND Corp., Santa Monica, Calif.

NETWORK-TYPE MANAGEMENT CONTROL SYSTEMS BIBLIOGRAPHY

B. L. Fry Feb. 1963 204 p 417 refs

(Contract AF 49(638)-700; Proj. RAND)

(RM-3074-PR)

This bibliography contains listings of documents indexed by title and author and covering the literature on network-type management control systems. R.C.M.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes: aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc.

For related information see: 03 Aerodynamics of Wings, Rotors and Control Surfaces; and 11 Fluid Mechanics.

N63-15307 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

STATIC AERODYNAMIC CHARACTERISTICS OF A THREE-STAGE ROCKET VEHICLE HAVING VARIOUS FIN CONFIGURATIONS AT LOW SUBSONIC MACH NUMBERS AND ANGLES OF ATTACK UP TO 28°

Clarence A. Brown, Jr. and Lawrence E. Putnam Washington, NASA, Apr. 1963 27 p 7 refs

(NASA TN D-1786) OTS: $0.75

The subsonic static aerodynamic characteristics of a 0.081- or 1/12-scale model of the Trailblazer II three-stage rocket vehicle were determined in the Langley low-turbulence pressure tunnel for application to the calculation of wind effects on vehicle trajectories. Included is a study of the effect of fin size and aspect ratio on the aerodynamic characteristics of the vehicle. The tests were made at Mach numbers near 0.2, at Reynolds numbers per foot from 7.06×10^6 to 9.01×10^6, and at angles-of-attack up to approximately 28°. Aerodynamic moments were taken about a point 34.555 inches (0.692 of the body length) aft of the model nose. This point corresponds to the center-of-gravity location of the loaded full-scale Trailblazer II configuration. The results showed that reducing the fin size at a fixed aspect ratio caused a decrease in lift and drag coefficients throughout the angle-of-attack range of the present investigation and a decrease in stability below an angle-of-attack of about 14°. Decreasing the fin aspect ratio at constant fin area resulted in a decrease in lift coefficient and stability below an angle-of-attack of about 14°. The results also show that all fin configurations were statically stable below an angle-of-attack of 14°, but that the configuration with fins of low aspect ratio and small area would be the least sensitive to ground winds at launch. Author

N63-15308 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AERODYNAMIC CHARACTERISTICS OF TOWED SPHERES, CONICAL RINGS, AND CONES USED AS DECELERATORS AT MACH NUMBERS FROM 1.57 TO 4.65

Nicholai Charczenko Washington, NASA, Apr. 1963 80 p 6 refs

(NASA TN D-1789) OTS: $2.00

An investigation was made to determine the drag and stability characteristics of spheres, conical rings, cones, and modified cones when towed in the wake of several space-vehicle configurations. The tests were made over a Mach number range of 1.57 to 4.65, with variation in the following parameters: Reynolds number, trailing distance, ratio of decelerator base diameter to space-vehicle base diameter, cone angle, and size of disk added to the base of a cone. In the flow behind a space vehicle, the drag coefficient for a decelerator is closely related to its stability characteristics in that the drag values are greater where a decelerator is stable. The 80° cone with an attached disk whose diameter is 10 percent larger than the base diameter of the cone has the highest drag coefficient values of any of the stable decelerators tested in this series. Considerable increase in drag-coefficient values can be obtained by increasing the ratio of the decelerator base diameter to the space-vehicle base diameter. Author

N63-15527 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECTS OF NOSE BLUNTNESS, FINENESS RATIO, CONE ANGLE, AND MODEL BASE ON THE STATIC AERODYNAMIC CHARACTERISTICS OF BLUNT BODIES AT MACH NUMBERS OF 1.57, 1.80, AND 2.16 AND ANGLES OF ATTACK UP TO 180°

David S. Shaw, Dennis E. Fuller, and C. Donald Babb Washington, NASA, May 1963 78 p 12 refs

(NASA TN D-1781) OTS: $2.00

Static aerodynamic data are presented for 34 blunt bodies which had nose bluntness of 0- (spherical), 50-, or 75-percent flat faces, fineness ratios of ½, ¾, or 1, cone half-angles of 10°, 15°, or 20°, and bases which were flat, convex, or concave. Tests were performed in the Langley Unitary Plan wind tunnel at Mach numbers of 1.57, 1.80, and 2.16 and through an angle-of-attack range of 180°. The test Reynolds number per foot was about 1.24×10^6. The results indicate that, from a static stability standpoint, all the models tested are unsuitable for use as a passive entry vehicle if the vehicle is to enter in the nose-forward condition, since the stable trim points near 180° could not be eliminated by their inherent aerodynamic characteristics. Increases in nose bluntness or fineness ratio and decreases in cone half-angles lead to decreases in stability near angles-of-attack of 0°. The model base had no effect on the stability near an angle-of-attack of 0°. Increases in nose bluntness or fineness ratio and decreases in cone half-angles lead to increases in normal force for most of the angle-of-attack range of 180°. The model base had no effect on normal force up to about 90° and only slight effects from 90° to 180° where the convex-base models had the highest values of normal force. Increases in nose bluntness, fineness ratio, or cone half-angles generally lead to decreases in axial force for angles-of-attack near 0°. The effects of model base are apparent only for angles-of-attack from 90° to 180°, and at 180°, the concave-base models had the most negative axial force while the convex-base models had the least negative axial force. Author

N63-15677 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux

MESURE DE COEFFICIENTS AERODYNAMIQUES INSTATIONNAIRES TRANSSONIQUES EN VOL LIBRE (UNSTEADY AERODYNAMIC COEFFICIENT MEASUREMENT IN TRANSONIC FREE FLIGHT)

Henri Loiseau Dec. 1962 27 p 4 refs In French; English summary (ONERA Note Tech. 69)

Unsteady flow measurements in wind-tunnels may be perturbed at high subsonic and transonic speeds, either by test-section resonance or by shock waves reflected by the walls on the models. A method of free-flight measurement has been developed. In this paper are described the flight tests of free-falling missiles on which four wings are mounted. These wings have different natural frequencies and are harmonically excited at regular intervals during flight. The response analysis provides flight damping and frequency whose varying values permit, according to the aim of the tests, either to calculate the unsteady aerodynamic coefficients or to check theoretical coefficients. Author

N63-15753 Boeing Scientific Research Labs. Flight Sciences Lab., Seattle, Wash.

SLENDER, TWO-DIMENSIONAL BODIES HAVING MINIMUM TOTAL DRAG AT HYPERSONIC SPEEDS

Angelo Miele and Robert E. Pritchard Feb. 1963 51 p 6 refs (Flight Sciences Lab.-TR-71; DI-82-0232)

The problem of minimizing the total drag (pressure drag plus friction drag) of a slender, two-dimensional, symmetric body is approached at zero angle-of-attack in hypersonic flow, under the assumption that the distribution of pressure coefficients is Newtonian and that the friction coefficient is constant. The condition that the pressure coefficient must be nonnegative is accounted for, as are the minimal problems for arbitrary conditions imposed on the thickness, the enclosed area, and the moment of inertia. The totality of extremal arcs in dimensionless coordinates is shown to be a two-parameter family of solutions in which each arc has two subarcs. From these sub-arcs, two classes of bodies are identified: regular shape only, and regular shape followed by a constant thickness contour. Solutions for minimizing the drag on each class of bodies—the optimum shapes, the thickness ratios, and the drag coefficients—are derived. D.E.R.

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes: ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N63-15389 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

MEASUREMENTS OF FLOW ANGLES IN VICINITY OF TWO LIFTING FOREBODY CONFIGURATIONS AT A MACH NUMBER OF 2.01

Odell A. Morris and Francis E. Mc Lean Washington, NASA, May 1963 39 p 5 refs

(NASA TN D-1640) OTS: $1.00

An investigation has been conducted in the Langley 4- by 4-foot supersonic pressure tunnel, at a Mach number of 2.01, to determine the flow properties in the vicinity of two lifting-forebody configurations. Measurements of the downwash and sidewash angles generated by the models were made at angles-of-attack of about 1°, 3°, and 5° for a range of chordwise, spanwise, and vertical-probe positions. Surface pressures were also measured on the models at two chordwise stations for the same angle-of-attack range. Results of the tests showed that large and rapid changes in the measured downwash and sidewash angles occurred for both models with variation in the survey-probe position in the region of the model trailing edge. Comparison of the experimental surface pressures with the theoretical values showed only fair agreement for both model configurations; however, the agreement for model B with the most severe twist and camber shape was good, inasmuch as the designed uniform-pressure distribution across the span was obtained. Author

N63-15432 Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

COMPUTATION OF ROTARY WING HARMONIC AIRLOADS AND COMPARISON WITH EXPERIMENTAL RESULTS

Raymond A. Piziali and Frank Du Waldt 26 p 7 refs Presented at the American Helicopter Soc., Eighteenth Annual Natl. Forum, Wash., D.C., May 2–4, 1962

(Contract DA-44-177-TC-698)

This investigation is an initial effort to obtain a solution to the steady-state rotating wing airloads problem by retaining a sufficient amount of the wake detail to enable accurate computation of the wake-induced velocities at the blade. The method of solution developed is numerical, utilizes high-speed digital computation, and is relatively simple to use. The method developed was used to compute the rotor airload distributions for the Bell HU-1A and an NASA model rotor in forward flight. These computed airloads were harmonically analyzed and the radial distribution of each harmonic compared with the measured distributions. In general, encouraging agreement was obtained in these comparisons. Effects of changing some of the parameters of the computation were investigated. Author

N63-15742 Aeronautical Research Council (Gt. Brit.)

CALCULATION OF STABILITY DERIVATIVES FOR TAPERED WINGS OF HEXAGONAL PLANFORM OSCILLATING IN A SUPERSONIC STREAM

Doris E. Lehrian London, HMSO, 1963 47 p 6 refs

(ARC-R&M-3298; Previously issued as ARC-22186) Available from HMSO: 18s. 6d.

The lift and pitching-moment derivatives due to slow pitching oscillations are evaluated for eleven symmetrically tapered wings. The planforms have supersonic leading and trailing edges of constant sweep, but varying side-edge rake and aspect ratio. Derivatives for Mach numbers $\sqrt{2} \leq M \leq 2{\cdot}4$ are calculated to first-order in frequency by linearized thin-wing theory. Thickness corrections for a 5% double-wedge section are also estimated by use of two-dimensional aerofoil theory; although these corrections are not large, comparison with measured pitching-moment derivatives is thereby improved. Author

N63-15743 Aeronautical Research Council (Gt. Brit.)

THE AERODYNAMICS OF JET FLAPS

J. Williams, S. F. J. Butler, and M. N. Wood London, HMSO, 1963 33 p 35 refs Presented at 2nd Intern. Congress of Aeronautical Sci., Zurich, Sept. 1960

(ARC-R&M-3304; Previously issued as RAE-R-AERO-2646; ARC-22823) Available from HMSO: 13s.

After introducing briefly the origin and primary concepts of jet flaps, this paper discusses progress toward the clarification and formulation of jet-flap aerodynamics. The aspects considered comprise lift, pitching moment and downwash, sideslip derivatives, and the effects of ground proximity. Some associated implications with regard to jet-flap aircraft performance, stability and control are also mentioned. Author

N63-15744 Aeronautical Research Council (Gt. Brit.)

AERODYNAMIC DERIVATIVE MEASUREMENTS ON A WING WITH A HORN-BALANCED CONTROL SURFACE

P. R. Guyett and J. K. Curran London, HMSO, 1963 39 p 10 refs (ARC-R&M-3307; Previously issued as RAE-R-STRUCT-263; ARC-23120) Available from HMSO: 15s. 6d.

Some oscillatory aerodynamic derivatives for wing pitch and translation and control-surface rotation have been found from measurements in a low-speed wind tunnel. The wing was a modified cropped delta of biconvex circular-arc section having a small leading edge radius and fitted with a horn-balanced control surface. The measurements covered a range of control-surface angles with the wing at a mean angle of incidence of 0°. Control-surface setting influenced the values of all derivatives, but the variation was small for angles in the range 0° to 5°. The wing lift and pitching-moment derivatives for wing motion at small control angles were in satisfactory agreement with theoretical results. Derivatives for control-surface rotation at small angles of the control were generally in reasonable agreement with values estimated using theoretical and semiempirical methods. Author

04 AIRCRAFT

Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N63-15312 National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

STATUS OF X-15 AERODYNAMIC-HEATING STUDIES

Richard D. Banner and Martin R. Kinsler (North Amer. Aviation, Inc. Los Angeles) N.Y., Am. Rocket Soc. [1961] 17 p 3 refs Presented at the ARS Missile and Space Vehicle Testing Conf., Los Angeles, Mar. 13–16, 1961

(ARS Paper 1629-61) ARS: $0.50 members, $1.00 nonmembers

One of the primary purposes of the X-15 program is to obtain full-scale aerodynamic-heating information that can be used to establish the adequacy of current theoretical methods and model tests. In conjunction with this purpose, a special flight was performed which maximized the heating rates and minimized the transient flight conditions. This flight reached a Mach number of 3.1. Results indicated a reasonable agreement between measured heat transfer data and simple theoretical predictions. Boundary-layer-transition data were obtained which pointed out a continuing problem of prediction that should probably be treated with conservatism until more detailed information is obtained. I.v.L.

N63-15353 Lear Siegler, Inc., Grand Rapids, Mich.

DISPLAY SYSTEMS FOR SUB- AND ZERO-GRAVITY FLIGHT [Final Report, Aug. 1961–Mar. 1962]

Robert Weiss Wright-Patterson AFB, Ohio, Behavioral Sci. Lab., Jan. 1963 63 p 26 refs

(Contract AF 33(657)-7199)

(AMRL-TDR-63-11) OTS: $1.75

A study was performed of the controls and pilot displays used to fly a C-131B and KC-135 aircraft in a Keplerian trajectory to create zero-gravity conditions. Evaluation criteria for this maneuver were proposed and applied to two basic instrumentation systems which were developed. An analog simulation was formulated and these results will be used to further improve the systems. Recommendations are made for improved instrumentation which should enable consistent flights of 10 seconds at zero-gravity plus or minus 0.005g. Author

N63-15424 Avco Corp. Flight Tech. Div., Wilmington, Mass.

SOUNDING ROCKET PAYLOAD ASSEMBLY AND TEST PROCEDURES (INCLUDING ORDNANCE INFORMATION AND RELATED DOCUMENTATION)

H. S. Jordan and W. T. Jarrett Sept. 5, 1962 55 p

(TDM-W-11, 774, Rev. 1)

Processing procedures for the Sounding Rocket Payload are described from payload receipt to launch. The Sounding Rocket Payload has been designed to determine the characteristics of wake generators. It consists of a dummy decoy with a timer-battery assembly and a wake generator, which are housed in a canister with an end cap fairing. In flight, the canister is jettisoned away away from the decoy body at a predetermined time, and then the wake generator is initiated. Assembly and test procedures, safety procedures, hold procedures, and special equipment are described. M.P.G.

N63-15526 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SIMULATOR STUDY OF THE LATERAL-DIRECTIONAL HANDLING QUALITIES OF A LARGE FOUR-PROPELLERED STOL TRANSPORT AIRPLANE

Hervey C. Quigley and Herbert F. Lawson, Jr. Washington, NASA, May 1963 26 p 4 refs

(NASA TN D-1773) OTS: $0.75

The lateral and directional stability and control characteristics of a large four-propellered STOL transport airplane (the boundary-layer-control equipped NC-130B) have been studied on the landing approach simulator to determine changes in the characteristics that might be required to achieve satisfactory lateral-directional handling qualities. The study has shown that the handling qualities can be improved by increased directional stability and damping. A large increase in stability in conjunction with increased yaw rate damping gave some improvement, but the reduced directional response to rudder inputs prevented the configuration from being rated satisfactory by the evaluating pilots. A satisfactory configuration was achieved by doubling the basic directional stability and including a damping term which gave yawing moments proportional to rate change of sideslip. Author

N63-15698 Army Missile Command, Redstone Arsenal, Ala.

PARAMETRIC DESIGN CURVES FOR SHORT RANGE, HIGH ACCELERATION BALLISTIC ROCKETS

Herman R. Oswell Apr. 1, 1963 42 p

(RF-TR-63-7)

This report is a compilation of design curves which will permit the rapid estimation of the effects of range, warhead weight, diameter, specific impulse, and propellant weight fraction on the weight and length of short-range, high-acceleration ballistic rockets. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes: celestial mechanics; and radioastronomy.

For related information see: 12 Geophysics; and 29 Space Sciences.

N63-15452 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

A COMETARY MECHANISM FOR THE FORMATION OF TEKTITES

R. A. Lyttleton Nov. 15, 1962 16 p 11 refs

(NASA Contract NAS7-100)

(JPL-TR-32-356) OTS: $1.60 ph, $0.80 mf

Passage of the earth through a comet must occur, on an average, approximately every million years and last for a few hours. A

proportion of short-period comets will have had sufficiently small eccentricity (less than about 0.6) for accretion of cometary material to occur during such passages and to produce a narrow jet of material projected vertically downward through the atmosphere. The orbits of these comets are such that the jet would be most likely to fall within lower latitudes, as is found for tektite fields. The temperature within the accretion stream would be sufficiently great to vaporize most materials, and the tektites are regarded as forming from the most refractory substances within the stream and are not characteristic of cometary compositions. The speeds of entry into the atmosphere are high enough for ablation to occur, and the dimensions of the resulting fields (chiefly arising because of the rotation of the earth during the passage) and their total masses agree in general order of magnitude with those estimated for actual fields. Author

N63-15470 Centro di Studio per la Fisica delle Microonde, Florence (Italy)

A FIRST RESULT ABOUT METEOR FLOW DERIVED FROM RADAR OBSERVATIONS Technical Note No. 3

N. Carrara, P. F. Checcacci, M. E. de Langer, and L. Ronchi Mar. 1963 26 p 10 refs

(Contract AF 61(052)-592)

The theoretical range distribution which should be observed under given experimental conditions has been evaluated by assuming that: (1) Sporadic meteor heliocentric radiants are uniformly distributed all over the celestial sphere. (2) Meteor flow is constituted of stone and iron meteors. (3) Meteor trail formation follows the Herlofson theory of ablation. Such distributions have been compared with the experimental-range distribution observed under the same conditions. At least one of these assumptions cannot be accepted. Author

N63-15514 Kyoto U. Inst. of Astrophysics (Japan)

ATMOSPHERIC MODELS OF WHITE DWARFS

Akira Uesugi 1962 33 p 38 refs Repr. from Mem. Coll. Sci., Univ. Kyoto, Ser. A (Osaka), v. 30, no. 2, art. 4, 1962 p 161-192 *Uts* Contrib. 117)

Model atmospheres with high surface gravity (log $g = 8$ and 9) are computed. The adopted values of effective temperature are 10,700°, 15,000° and 20,000° K, respectively. The normal abundance ratio of hydrogen to helium (N_H: N_{He} = 85:15) is assumed. These models have higher electron pressure and opacity compared with main-sequence models. The H_γ and H_δ profiles are computed based upon these models. The effect of wing overlapping is serious, since the wings of these lines extend more than 100 Å from each line center. The ratio, $W(H_\delta)/W(H_\gamma)$, is small and agrees with the observed value. $U - V \sim \theta_e$ relation is also computed. The effective temperature derived from this relation is lower than that in Greenstein's temperature scale. Comparisons of Balmer line profiles with observed ones are done by means of this temperature scale. It is found that the computed line absorption is too small compared with the observed one. Correction to the temperature distribution law for the constancy of net flux F(τ) throughout the atmosphere is applied to the models with T_e = 10,700° K with the aid of Swihart's method. The corrected surface temperature becomes much lower, and $\frac{\Delta F(\tau)}{F}$ is less than 1 percent. For our corrected model, the computed profiles of Balmer absorption lines agree fairly well with the observed ones. Author

N63-15615 National Aeronautics and Space Administration, Washington, D.C.

NASA, SMITHSONIAN ASTROPHYSICAL OBSERVATORY TO SET UP METEORITE NETWORK News Release No. 62-266

Dec. 23, 1962 3 p

Available from NASA, Office of Scientific and Technical Information, Wash., D.C.

The program proposed by NASA and the Smithsonian Astrophysical Observatory to construct a network of sixteen stations in seven Midwestern States for photographing bright meteorites is outlined. This photography and recovery program, the Prairie Network, will concentrate on the structure, composition, and radiation of the meteorites. Each station will be equipped with four automatic cameras to fix the location of the meteorite's impact point as well as its orbital path in space before impact. The stations are described and their locations are pinpointed. D.E.R.

N63-15706 National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

UNDERSTANDING THE MAIN-SEQUENCE STARS

Su-Shu Huang Repr. from Sky and Telescope, v. 25, no. 3, Mar. 1963 4 p

The basic relations for classifying stars are reviewed to try to obtain a stable method of classification and a means of identification for the stars commonly observed. The relations are: (1) A star's luminosity is proportional to its mass raised to some power, (mass-luminosity). (2) A star's luminosity is determined by its effective temperature and radius (mass-radius). Then it follows that, for a given mass, small stars must be at higher average temperatures than large ones, to have proportional luminosities; and, for a given radius, the more massive stars have higher temperatures in their interiors. This relation holds true for all stars in their main sequence, which comprise most of the stars observed. Stellar evolution is also reviewed, and it is found that stars tend to evolve and change because of their internal gravitation and the radiation of energy from their surfaces. But the release of nuclear energy arrests the evolution as long as the hydrogen in the central region remains. So only the main-sequence stars show a constancy in physical characteristics. Finally, the stellar life-span is divided into three parts: growth, the long stage of maturity, and a final decline to the end of activity. The main sequence represents the long stage of maturity of the stars. D.E.R.

N63-15736 Centro di Studio per la Fisica delle Microonde, Florence (Italy)

RADAR-ECHO OBSERVATIONS OF QUANDRANTIDS SHOWER Technical Note No. 4

S. Ceccarelli Mar. 1963 25 p

(Contract AF 61(052)-592 and Conseglio Nazl. delle Rec. of Italy)

Special observations of meteor echoes were made during the first days of January 1962, on the occasion of the Quandrantids shower. Observations during the last days of December 1961 were made, too, for comparison. The data observed were elaborated with the same procedure employed in preparing our monthly Meteor Data Bulletins. The results are reported here. Author

06 AUXILIARY SYSTEMS

Includes: fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters.

For primary propulsion systems see: 27 Propulsion

For related information see: 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; and 22 Navigation and Guidance.

N63-15711 Radio Corp. of America. Semiconductor and Materials Div., Somerville, N.J.

INVESTIGATION OF NEW CATHODE-ANODE COUPLES FOR SECONDARY BATTERIES USING MOLTEN SALT ELECTROLYTES [Final Report, Nov. 1961-Nov. 1962]

E. F. Uhler, G. Stockdale, P. Ritterman, and G. S. Lozier Wright-Patterson AFB, Ohio, Directorate of Aeromechanics, Jan. 1963 81 p 27 refs
(Contract AF 33(657)-7758)
(ASD-TDR-63-115)

A final report is presented covering an investigation of the most direct and systematic approach in selecting the most promising materials for the development of higher capacity secondary batteries for space applications. The experimental approach, materials, and necessary precautions required in molten-salt technology are summarized. Advantages and disadvantages of the various molten-salt electrolytes considered are presented. Experimental procedures and couple materials investigated are discussed. The experimental results for the molten-salt cells investigated are presented. Data are presented for cells with fluoride, chloride, and sulfate molten-salt electrolyte. Objectives and results of a ceramic separator study phase of the program are included. The design of a molten-salt secondary battery which was constructed during the course of the program is described, along with fabrication procedures of this battery. Theoretical calculation for the initial heat input versus heat output and the heat loss due to cell radiation is presented. Author

07 CHEMISTRY

Includes: chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis.

For related information see: 18 Materials, Metallic; 19 Materials, Non-metallic; and 26 Propellants and Combustion.

N63-15271 New York U. Coll. of Engineering, N.Y.
KINETICS AND THERMODYNAMICS FOR THE REDUCTION OF SPACE MINERALS BY HYDROGEN (APPENDIX)
Kurt Komarek *In its* Production of Oxygen from Space Minerals Feb. 1, 1963 p A1–A14 8 refs (See N63-15270 12-16)
OTS: $4.60 ph, $1.46 mf

The composition of stone meteorites is given in tabular form and the oxygen content and its distribution among the other elements is calculated. The table is then used as the basis of thermodynamic calculations for investigating the feasibility of reducing these meteorites with hydrogen. The reactions are given and stoichiometric calculations are included. D.E.R.

N63-15280 Stanford Research Inst., Menlo Park, Calif.
SPECIALTY SILICONE ELASTOMERS Final Report
S. A. Fuqua and R. M. Silverstein Apr. 25, 1962 39 p 9 refs
(Contract DA-11-070-508-ORD-906)

The synthesis and polymerization of a new class of silane monomers, the α,ω-bis-[(ethoxydimethylsilyl)-phenyl]-perfluoroalkanes, are reported. These have been prepared from the intermediate α,ω-bis-(bromophenyl)-perfluoroalkanes, three of which are described. 1,2-bis-[p-(ethoxy-dimethylsilyl)-phenyl]-tetrafluoroethane and 1-[p-(ethoxydimethylsilyl)-phenyl]-3-[m-(ethoxydimethylsilyl)-phenyl]-hexafluoropropane, prepared from the corresponding bis-bromophenyl compounds, have been homopolymerized. The former monomer yielded a solid homopolymer, but it could be copolymerized with diethoxydimethylsilane to form a more suitable gum. The latter monomer gave a homopolymeric gum. This polymer, upon heating in a vacuum, depolymerized, forming an unusual monomeric cyclic disiloxane. The synthesis of 1,3-bis-[p-(ethoxydimethylsilyl)-phenyl]-hexafluoropropane from the third bis-(bromophenyl)-perfluoroalkane was unsuccessful on a preparative scale. Author

N63-15301 California U., La Jolla. Scripps Inst. of Oceanography
ELECTRON MICROPROBE ANALYSIS OF SOME RARE MINERALS IN THE NORTON COUNTY ACHONDRITE
Klaus Keil and Kurt Fredriksson [1963] 28 p 21 refs Submitted for Publication
(NASA Grant NsG-322-63)
OTS: $2.60 ph, $1.04 mf

The composition of the minerals constituting the Norton County achondrite has been ascertained by measuring a large number of individual grains of each mineral, using electron-microprobe techniques. The following minerals were found: enstatite, forsterite, metallic nickel-iron, metallic copper, daubreelite, troilite, and two new species, titanoan troilite and ferromagnesian alabandite. The unusual association of minerals indicates that, when this meteorite was formed, the environment was strongly reducing, and any hypothesis on the origin of meteorites, based on comparison with terrestrial rock-forming mechanism, must take this into account. Author

N63-15309 National Bureau of Standards, Washington, D.C.
CALORIMETRIC DETERMINATION OF HALF-CELL ENTROPY CHANGES
J. M. Sherfey (NASA. Goddard Space Flight Center) Repr. from J. Electrochem. Soc., v. 110, no. 3, Mar. 1963 p 213–221 9 refs
(Supported by the AEC)

The reversible heat effects ($T\Delta S$) of half-cell processes have been measured in a twin calorimeter consisting of a Dewar flask divided into two halves by means of a vertical partition. Both compartments contain the same electrolyte and each has an electrode. A hole in the partition, covered by filter paper, permits the passage of electrolytic current between the compartments. The total heat effect and the heat due to irreversible phenomena are measured separately for each compartment. The difference between these two gives the desired reversible heat. The half-cells studied include copper in acid copper sulfate, silver in acid silver perchlorate, and silver-silver chloride in various chloride solutions. The effect of "transport entropies" on these measurements is outlined. Presently accepted theories of the "irreversible" or "steady-state" thermodynamics of electrolytic cells predict the equivalence of half-cell entropy data obtained by the present calorimetric method and data obtained from thermocell studies. This predicted agreement was not obtained in the case of the half-cell silver-silver perchlorate. Author

N63-15315 Southampton U. (Gt. Brit.)
RESEARCH ON ELECTRONICALLY EXCITED STATES AND THEIR REACTIONS Final Technical Report
R. C. Cookson Apr. 26, 1962 33 p 25 refs
(Contract AF 61(052)-191)
(AFCRL-62-860)

The reaction of dienes, especially bicycloheptadiene, with metal carbonyls has been thoroughly explored, resulting in the isolation of a range of ketones and hydrocarbons, the structures and stereochemistry of most of which have been worked out. Both double bonds of the cyclo-octatetraene–maleic acid adduct take part in electrophilic addition, forming tetracyclic products. The unusual rearrangement of the acetylenedicarboxylic ester adduct to derivatives of naphthalene-2:6-dicarboxylic ester has been reinvestigated. The Woodward–Katz rearrangement of 8-oxo-dicyclopentadiene takes place very rapidly and is catalyzed by Lewis acids. Such acid catalysis has been extended to the intermolecular Diels–Alder reaction. Ultraviolet irradiation of dimethylbenzoquinones gives a series of cis dimers and trans dimers by addition of two double bonds to form a cyclobutane ring. The cis dimers undergo a second reaction of the same sort to give saturated, box-shaped molecules; the 1-Oxo-dicyclopentadiene gives a cage-photoisomer that is remarkably stable. Although attempts to change aromatic compounds to the Dewar isomers (bicyclo [2.2.0] hexadienes) by irradiation all

failed, reduction of dichlorotetramethylcyclobutene in acetylenes did give the aromatic tetramethylbenzenes. The reaction is assumed to go through the Dewar isomers. The geometrical conditions for charge-transfer and intensification of the $n \rightarrow \pi^*$ transition of unsaturated ketones are exemplified, and the ability of the mixing of the two transitions to give rise to high optical rotatory power is emphasized. Author

N63-15348 Wayne State U., Detroit, Mich.

EXPERIMENTAL INVESTIGATIONS ON THE LIGHT SCATTERING OF COLLOIDAL SPHERES. V. DETERMINATION OF SIZE DISTRIBUTION CURVES BY MEANS OF SPECTRA OF THE SCATTERING RATIO Technical Report No. 4 (50)

W. Heller, M. L. Wallach, and A. F. Stevenson Apr. 15, 1963 27 p refs

(Contract Nonr-3511(00))

The practical applications of a method developed to determine particle size from the light-scattering ratio σ spectrum in heterodisperse colloidal dispersions of nonabsorbing spheres are presented. The theoretical variation of the scattering ratio shows that its spectrum will exhibit a series of maxima and minima at constant particle size; these maxima and minima move to longer wavelengths and become shallower as the system becomes more and more heterodisperse. The spectral location of σ maxima and minima, and the amplitude of the spectral oscillations of σ with size, requires the use of a distribution curve similar to a log-normal distribution except that it generally begins at a finite particle size. As an example of the application of this method, experimental results for heterodisperse lattices of polystyrene are calculated using the log-normal distribution curve. Four approximate methods are also described for use when theoretical and experimental σ spectra do not match satisfactorily. The advantage of the light-scattering method is that the colloidal systems under investigation are not disturbed, and the accuracy of the data obtained depends on the spread of the distribution curve and on the size of the smallest particles present in consequential numbers. M.P.G.

N63-15354 Rice U., Houston, Tex.

THE CRYSTAL STRUCTURE OF PROPIONIC ACID

Frederick J. Strieter, David H. Templeton (Calif. U., Berkeley) Ronald F. Scheuerman, and Ronald L. Sass Repr. from Acta Cryst. (Copenhagen), v. 15, pt. 12, Dec. 1962 p 1233–1239 17 refs

(NASA Grant NsG-6-59)

The structure of propionic acid crystals has been determined in two independent investigations of single crystals by X-ray diffraction. The crystals are monoclinic, space group $P2_1/c$. The unit cell dimensions according to one study at −95° C are: a = 4·04 ±0·04, b = 9·06 ±0·01, c = 11·00 ±0·01 A; B = 91° 15′ ±8′. According to the other work at −135° C: a = 4.07 ±0·01, b = 9·04 ±0·01, c = 10·97 ±0·01 A; B = 90° 56′ ±8′. Atomic coordinates were refined in each case by least-squares methods to give substantially the same structure. Propionic acid molecules occur in the crystal as centric and nearly planar dimers with hydrogen bonds of length 2·64 Å. Other bond lengths are: C—O, 1·23 and 1·32 Å; C—C(α), 1·50 Å; C—C(B), 1·54 Å, all with standard deviations of about 0·01 Å. Author

N63-15371 Aberdeen Proving Ground. Coating and Chemical Lab., Md.

FEASIBILITY STUDY ON THE DEVELOPMENT OF A ONE COAT PAINT SYSTEM

Melvin H. Sandler Mar. 20, 1963 33 p 9 refs

(CCL-138)

This report covers a feasibility study on the development of a one-coat paint system that can be applied at the same total dry-film thickness of a primer-topcoat system and provide equal or better corrosion protection. Although a one-coat system was developed to offer comparable protection, the advantage of one-coat application was considered to be offset by the fact that a primer-topcoat system would materially lessen the possibility of "holidays" occurring in the paint film and would assure the deposition of a more uniform coating. Author

N63-15414 Aerojet-General Corp. Chemical Products Div., Azusa, Calif.

RESEARCH AND DEVELOPMENT OF HIGH-TEMPERATURE-STABLE INORGANIC RESINS AND ELASTOMERS [Final Report] 1 July 1961 through 21 June 1962

J. Feltzin Aug. 1962 45 p

(Contract DA-04-495-ORD-3075)

(Rept. 2365)

The objective of this work was to conduct research and development for the preparation of inorganic elastomers. Methods for modifying and utilizing basic natural silicates for the preparation of elastomers were investigated. A reaction of an organohalosilane with a silicate yielding elastomeric materials was discovered. Methods designed to improve the physical and mechanical properties of the materials by changes in structure and by increasing molecular weight were investigated. Author

N63-15416 Hughes Aircraft Co. Aerospace Group, Culver City, Calif.

ROCKET LINER PROGRAM Eighth Quarterly Report, 1 Apr. 1962–1 July 1962

S. B. Eglin and A. L. Landis [1962] 24 p 5 refs

(Contract DA-04-495-ORD-3079)

(ROC/LIN-80)

Means of catalytically equilibrating stannosiloxane polymers to increase polymer chain length and of achieving effective curing of phenyl-containing stannosiloxane polymers have been investigated. Thus far, equilibration procedures employed which have resulted in increased molecular weight and bulk viscosity of these polymers have also resulted in apparently irreversible cleavage of silicon-oxygen-tin linkages. Results obtained in curing experiments with phenyl-containing stannosiloxanes have been encouraging. Copolymers having silanol functional groups along the chain have yielded cured compositions with measurable tensile strength and extensibility upon heating, and after compounding with elemental sulfur, a silicon hydride, and inert fillers. Phenyl-containing copolymers having vinyl-group functionality can be cured by the same procedure, but cures are susceptible to air inhibition. Author

N63-15440 United Technology Corp. Research and Advanced Technology Div., Sunnyvale, Calif.

THERMOCHEMISTRY OF OXYGEN-FLUORINE BONDING Final Technical Summary Report, Mar. 1, 1961 through Feb. 28, 1963

C. E. Fogle, R. T. Rewick, J. C. Trowbridge, and J. D. Breazeale Mar. 29, 1963 44 p 36 refs

(Contract NOnr-3433(00); ARPA Order 184-62)

(UTC-2002-FR)

The objectives of the work reported herein have been the determination of the strengths of oxygen-fluorine bonds in chemical species from thermochemical data and the correlation of the variations of the bond strength to the molecular structure. The ultimate purpose has been the definition of a sufficiently general O-F bond energy to permit a valid theoretical evaluation of the potential of species containing this grouping as rocket propellant oxidizers. As a consequence of this work, a reasonable heat of formation for O-F bonded species may be generated, employing a single representative value for the strength of this bond. A narrow range of values (37 to 47 kcal/mole) for the O-F bond energy was obtained from the heat of formation and normal assumptions for the other bonds present in the molecule for the species for which data was obtained or available. The average value for the energy of the O-F bond for all O-F bonded species was found to be 43 kcal/mole, which corresponds very closely to the value of 45 kcal/mole derived from the

heat of formation of oxygen difluoride. The variation found in the O-F bond energies for the species is less than is observed for other bonds. Author

N63-15441 Oak Ridge National Lab., Tenn.

REACTOR CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1963

W. R. Grimes, E. G. Bohlmann, H. F. Mc Duffie, G. M. Watson, F. F. Blankenskip, and C. H. Secoy May 1, 1963 329 p refs
(Contract W-7405-eng-26)
(ORNL-3417) OTS: $4.00

Progress in the reaction chemistry experiments of the chemical division of the Oak Ridge atomic-energy study is reported. Projects include: the molten-salt reactor program, the aqueous reactor program, heterogeneous systems, high-temperature solid-fueled reactors, the irradiation behavior of high-temperature reactor materials, nuclear safety program, and other various reactor chemistry support programs for the nuclear ship Savannah. D.E.R.

N63-15451 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

RELATIVE SIGNS OF FLUORINE-19-FLUORINE-19 AND HYDROGEN-1-FLUORINE-19 N.M.R. COUPLING CONSTANTS

Dennis F. Evans (Imperial Coll., London), Stanley L. Manatt, and Daniel D. Elleman Repr. from J. Am. Chem. Soc., v. 85, Jan. 1963 p 238–239 3 refs Presented at the Symp. on High-Resolution N.M.R. Spectroscopy, Colo. U., July 3, 1962
(NASA Contract NAS7-100)
(JPL-TR-32-369)

The results of some double resonance studies which have given the relative signs of several types of Fluorine-19–Fluorine-19 and Hydrogen-1–Fluorine-19 coupling constants in fluorocarbon compounds are presented. The nuclear magnetic resonance signs of the two coupling constants are found to be proportional to one another in equal concentrations. D.E.R.

N63-15482 Cornell U., Ithaca, N. Y.

FLUORINE FREE RADICAL CHEMISTRY Final Report, Oct. 1959-Oct. 1962

William T. Miller, Jr. [1962] 41 p
(Contracts DA-069-ORD-2521 and DA-ORD-31-124-61-G85)
(AROD-2289-4)

The results of experiments designed to provide an increased understanding of the reactions which take place when organic compounds are brought into contact with elemental fluorine and to furnish new methods of synthesis for highly fluorinated compounds are presented. These results are: the development of a new apparatus for liquid-phase fluorination using a high-speed nickel-wire gauze stirrer; the demonstration of the effect of fluorine concentration on the reaction products obtained from perhaloolefins over a wide range of reaction conditions; the fluorination of hydrocarbons to yield three possible fluorine dimer-addition products in predictable amounts; the study of olefin-fluorine reactions at low temperatures, in the liquid phase; the probability of the fluorine-olefin reaction being a free-radical type of reaction mechanism is substantiated; the development of general criteria for the conditions of the fluorine-per-haloolefin reaction; the fluorination of an acetylene has been carried out and the product's reactivity compared with a butene. D.E.R.

N63-15495 Borden Chemical Co. Central Research Lab., Philadelphia, Pa.

STUDY LEADING TO THE DEVELOPMENT OF REINFORCED HIGH TEMPERATURE ELASTOMERS Quarterly Progress Report No. 1, 16 Sept.-31 Dec. 1962

K. C. Tsou, S. J. Makower, R. N. Goldey, and B. D. Halpern [1963] 34 p 5 refs
(Contract DA-36-034-AMC-3791-W)

A new synthesis of triphenyl silyl modified hi-sil X-303 is reported using silicon chloride and phenyl lithium. But silicone elastomers containing this filler give poor results due to trace amounts of lithium chloride in the filler. The trimethylsilyl modified filler shows high tensile strength at 45 parts per loading. The addition of diphenyl silanediol to silicone rubber improves the high-temperature elongation, and tentative mechanisms for the filler-rubber interaction are set forth as new developments in high-temperature elastomer research. D.E.R.

N63-15499 Armour Research Foundation, Chicago, Ill.

RESEARCH ON CHEMISTRY OF O_3F_2 AND O_2F_2 Technical Summary Report, Jan. 1 through Mar. 31, 1963

Irvine J. Solomon Apr. 25, 1963 16 p
(Contract AF 49(638)-1175; ARPA Order 350-62)
(ARF 3227-3)

It has been found that O_2F_2 does not decompose directly to oxygen and fluorine; reactive intermediates are formed first. Oxygen difluoride is formed as a byproduct in the synthesis of O_2F_2, but it is not a decomposition product. The OF_2 is removed when the O_2F_2 is pumped on at $-196°$ C. The compounds O_2BF_4 and O_2PF_6 have now been fully characterized. Apparently, in both of these compounds, the O_2^+ ions pair to a large extent, giving rise to O_4^{++} ions. A study of the reaction of O_2F_2 with phosphorus is continuing. In addition to the simple phosphorus fluorides, POF_3 and an interesting brown compound have been detected in the reaction products. Author

N63-15519 Feltman Research Labs., Picatinny Arsenal, Dover, N.J.

THE PREPARATION OF CARBON-14 LABELED TETRAMETHYLAMMONIUM BROMIDE

Andrew F. Smetana, Jerome Haberman, and Thomas G. Castorina Apr. 1963 16 p 9 refs
(Picatinny Arsenal -TM-1167)

Carbon-14 labeled tetramethylammonium bromide was prepared via the condensation of C-14 methyl bromide with trimethylamine using high-vacuum techniques. Unrecrystallized product yields, in the range of 100% of theory (based on methyl bromide), are independent of variations in excess quantities of trimethylamine. C-14 methyl bromide is effectively derived from an intermixture of C-14 methyl iodide with methyl bromide in the ratio of 1:350. A series of preparations from aliquots of the stock CH_3I/CH_3Br mixture result in reproducible yields and specific activities of 1.8% average deviation. Author

N63-15524 Aeronautical Systems Div. Physics Lab., Wright-Patterson AFB, Ohio

THE GAS PHASE RADIOLYSIS OF 2-BUTYNE [Final Report, Mar. to Dec. 1962]

L. A. Harrah, R. E. Rondeau, S. Zakanycz, D. Hale, and D. Dunbar Feb. 1963 19 p 7 refs
(ASD-TDR-63-65)

Pyrex ampoules of gaseous 2-butyne (dimethylacetylene) were exposed to cobalt-60 gamma rays, and the hundred electron-volt yields of the lower molecular weight products are given. The radiation-induced products were studied as a function of sample pressure and total dose. The products, which include hydrogen, methane, acetylene, propene, propyne, cis- and trans-2-butene, butane, 1,2-butadiene, and vinylacetylene, are explained on the basis of ion-molecule and free-radical reactions. Some mechanisms of product formation which are consistent with product distribution and magnitude of the yields are discussed. Author

N63-15529 Frankford Arsenal, Philadelphia, Pa.

ENGINEERING AND LABORATORY EVALUATION TO IMPROVE TEST PROCEDURES IN MILITARY SPECIFICATION JAN-P-670, STABILIZED RED PHOSPHOROUS

George Norwitz, Joseph Cohen, and Martin E. Everett Mar. 1963 21 p 21 refs
(Test Rept. T63-8-1)

Methods for the determination of copper, iron, aluminum, and yellow phosphorus present in red phosphorus, as well as the determination of the oxidation rate of red phosphorus, are investigated. Results are as follows: (1) An improved calorimetric procedure for copper is proposed whereby the sample is dissolved in nitric acid and the solution is evaporated until the perchloric acid, which was added after the nitric acid, fumes. Ammonium citrate, ethylenediamine tetraacetic acid, and diethyldithiocarbamate are added. The diethyldithiocarbamate complex is extracted with chloroform. (2) An improved calorimetric procedure for iron is proposed whereby the sample is dissolved in nitric acid. The solution is evaporated to a small volume, and hydroxylamine hydrochloride, *o*-phenanthroline, and sodium citrate are added. (3) It is recommended that the aluminum be determined by the 8-hydroxyquinoline procedure used by the National Bureau of Standards. (4) The use of the classical magnesium ammonium phosphate method is recommended for the determination of the total phosphorus. (5) The methods previously proposed for the determination of yellow phosphorus and granulation are satisfactory. (6) The oxidation test for red phosphorus has been improved by the use of a definite amount of water (0.5 ml) in the bomb. I.v.L.

N63-15542 Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho
ORGANIC COOLANT DEGRADATION STUDIES
D. G. Kuper AEC National Reactor Testing Station Mar. 25, 1963 14 p 2 refs
(Contract AT(10-1)-205)
(IDO-16851) OTS: $0.50

The rates of thermolytic decomposition of purified biphenyl, o-terphenyl, and m-terphenyl were measured at 750° F, 775° F, 800° F, and 825° F. The liquid phases have been analyzed and the data interpreted by first-order kinetics. Reaction rate constants, energies of activation, and entropies of activation were calculated for each material tested. The results show that o-terphenyl degrades about five times faster than biphenyl or m-terphenyl. In the breakdown, it seems likely that a complex of high entropy is formed, which subsequently reacts or decomposes to give the observed breakdown products. A limited study was made on the combined effects of temperature and gamma radiation. The results show an increase of the radiolytic decomposition with temperature. Author

N63-15555 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE EXPERIMENTAL INVESTIGATION OF ELECTROCHEMICAL OXIDATION AND DISSOLUTION OF MOLYBDENITE (EKSPERIMENTAL'NOE ISSLEDOVANIE ELEKTROKHIMICHESKOGO OKISLENIYA I RASTVORENIYA MOLIBDENITA)
A. S. Mikhailov London, Ministry of Aviation, Mar. 1963 13 p 16 refs Transl. by J. W. Palmer from Geokhimiya (Moscow), 1962, p 818–825
(RAE Library Translation 1030)

Experiments are described on the electrochemical oxidation of molybdenite. The material, when pure, belongs to the group of conducting materials and has a more positive electrode potential than most other sulphide minerals. Products of oxidation between the lamellae result in the semiconductor properties often ascribed to MoS_2. The powder, either alone or mixed with other sulphides, undergoes electrochemical oxidation with and without the passage of a current. The chemical changes are complex and shown to be dependent on the pH and type of electrolyte, and, on the difference in electrode potential between the MoS_2 and other powders present. Author

N63-15611 Princeton U. Frick Chemical Lab., N.J.
THE ROLE OF HYDROGEN BONDS IN THE VISCOELASTIC PROPERTIES OF AMORPHOUS POLYMER NETWORKS
M. C. Shen and A. V. Tobolsky Jan. 1963 38 p 12 refs Submitted for Publication
(Contract Nonr-1858(07))
(ONR Tech. Rept. RLT-55)

The influence of hydrogen bonds on the viscoelastic properties is studied by constructing the modulus-temperature curves of a series of homopolymers and copolymers of methacrylates. It is seen that only the inflection temperature change as a function of the degree of hydrogen bonding. The glassy moduli, the rubbery moduli, and the slopes at the transition region remain essentially constant. Physical interpretations on the molecular scale are given to explain the experimental observations. Author

N63-15622 Feltman Research Labs., Picatinny Arsenal, Dover, N.J.
DIFFERENTIAL THERMAL ANALYSIS OF POTASSIUM PERCHLORATE
David A. Anderson and Eli S. Freeman Mar. 1963 11 p 8 refs
(Picatinny Arsenal-TR-3046)

Differential thermal analysis and thermogravimetric analysis experiments were carried out on potassium perchlorate. The thermograms clarify conflicting reports in the literature concerning details of decomposition and elucidate the thermodynamics of this reaction. Author

N63-15648 European Atomic Energy Community, Brussels (Belgium)
DETERMINAZIONE DELL'OSSIGENO NEL MONOCARBURO DI URANIO MEDIANTE ESTRAZIONE A CALDO NEL VUOTO (DETERMINATION OF OXYGEN IN URANIUM MONOCARBIDE BY VACUUM HOT EXTRACTION)
A. Colombo Joint Nuclear Research Center, Ispra Establishment (Italy), Chem. Serv., Mar. 1963 11 p 2 refs In Italian; English abstract
(EUR-204.i) Available from Belgian American Bank and Trust, N.Y., account no. 121.86: 25 Belg. Fr.

The reproducibility of the hot-extraction technique for determining oxygen in uranium monocarbide, using commercial vacuum-fusion equipment, was investigated. Gases are extracted by dropping the samples in a graphite crucible heated at 1960°C under vacuum, and are analyzed by means of a gas chromatograph. With a sample weighing 50 to 100 mg, oxygen has been determined with a relative standard deviation of about ±5% in the range 500 to 1000 ppm weight oxygen. The sensitivity of the analysis could be increased by increasing the sample size. Some indications on the behavior of the uranium monocarbide under different storage conditions are given. Author

N63-15705 Aerospace Corp. Labs. Div., El Segundo, Calif.
ENERGY CONVERSION: ELECTRICAL PROPERTIES OF ORGANIC COMPOUNDS Semiannual Technical Report, 1 July-31 Dec. 1961
H. H. Takimoto, P. C. Marx, G. C. Denault, and L. O. Krbechek Feb. 9, 1962 41 p 26 refs
(Contract AF 04(647)-930)
(DCAS-TDR-62-19; TDR-930(2220-20)TR-1)

The objective of this program is to determine the mechanism of electronic-conduction process in organic compounds to provide data for the development of new solid-state and energy-conversion concepts. Syntheses of structures related to 7,7,8,8-tetracyanoquinodimethane, whose derivatives have been reported to exhibit extremely high conductivities ($10^2 ohm^{-1}cm^{-1}$), as well as other polycyano and polyhydroxyaromatic compounds, were investigated.

Electrical properties, such as conductivity, photoelectric effects, radiofrequency loss angle, mobility, and lifetime of charge carriers, will be determined. From such investigations, it should be possible to deduce the nature of the electronic-conduction process in organic compounds. Author

N63-15746 National Research Corp., Cambridge, Mass.
HEAT OF FORMATION OF $LiAlH_4$ Special Report
Ludwig G. Fasolino Apr. 26, 1963 28 p 13 refs
(Contract Nonr-3608(00))

The heat of formation of lithium aluminum hydride ($LiAlH_4$) has been determined by measuring the heats of solution of aluminum, lithium, and lithium aluminum hydride in 4N HCl. The heat of formation of lithium aluminum hydride was calculated to be:

$$\Delta Hf^\circ \text{ at } 25^\circ C = -26.63 \pm 0.31 \text{ kcal/mole.}$$

The value determined in this work alters any chemical propulsion calculation utilizing this information. Author

08 COMMUNICATIONS

Includes: communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation.

For tracking stations see: 10 Facilities.

For related information see: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation; and 22 Navigation and Guidance.

N63-15254 RAND Corp., Santa Monica, Calif.
ON SYNCHRONIZATION IN COMMUNICATION THEORY
I. S. Reed Mar. 1963 17 p
(Contract AF 49(638)-700; Proj. RAND)
(RM-3561-PR)

The author extends Shannon's definition of a discrete transducer *without* noise to one *with* noise. In particular, a *lossless* transducer with noise is defined and an example is presented; it is demonstrated that the capacity of such a device can be calculated. A model for a time-varying channel is presented, and it is suggested that for some types of time-varying channels, comma-free coding would be required to establish word synchronization. Author

N63-15256 National Committee for International Geophysical Coordination, Science Council of Japan, Tokyo
POST-IGC DATA ON ATMOSPHERICS, WHISTLERS AND SOLAR RADIO EMISSIONS, VOLUME VIII, 1 JANUARY TO 30 JUNE 1961
A. Kimpara, H. Ishikawa, K. Sao, and H. Tanaka, eds. 1962 238 p

Statistics are presented for atmospheric noise measurement, atmospherics average intensity, sudden enhancement of the atmospherics, intensity of atmospheric radio noise, whistler data, and solar radio emissions. J.A.J.

N63-15277 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
TUNABLE, HIGH STABILITY, MICROWAVE OSCILLATOR
R. L. Poynter and G. R. Steffensen Repr. from The Review of Sci. Instrs., v. 34, no. 1, Jan. 1963 p 77–82 12 refs
(NASA Contract NAS7-100)
(JPL-TR-32-392)

This paper describes a microwave oscillator which is phase stabilized to a high-order microwave harmonic from a stable frequency standard, and which may be conveniently tuned through any selected 200-mc band in the microwave frequency range. One form of this oscillator has a stability of a few parts in 10^8 throughout the 200-mc turning range, while a slightly more complex form has a stability of a few parts in 10^8 through a reduced tuning range. While this oscillator has only been applied to a high-resolution microwave spectrometer and to the spectrum analysis of stable cw microwave signals, it is also well adapted to gas-beam maser spectroscopy. Author

N63-15296 National Aeronautics and Space Administration, Washington, D.C.
THE DISTANT GEOMAGNETIC FIELD. 2. MODULATION OF A SPINNING COIL EMF BY MAGNETIC SIGNALS
C. P. Sonett (NASA, Ames Research Center) Repr. from J. Geophys. Res. v. 68, no. 5, Mar. 1, 1963 p 1229–1232 1 ref

The modulation of a spinning-search-coil signal by time-variant magnetic fields is discussed. For typical spacecraft usage, dipolar inhomogeneity produces a trivial signal. The primary contributions to the signal arise from the coil spin and field time variance. Variations in the scalar value of the field produce both amplitude and phase modulation. In a base field like the earth's with superimposed fluctuations, amplitude modulation from Alfvén waves is usually trivial. The amplitude power spectrum depends on both the spin rate of the spacecraft and the Fourier decomposed frequencies of the fluctuations. Where frequencies near the spin are encountered, spectral inversion can result from what becomes effectively the mixing of two carrier signals. Author

N63-15324 Purdue U. School of Electrical Engineering, Lafayette, Ind.
ADVANCED COMMUNICATION THEORY TECHNIQUES
J. C. Hancock, D. G. Lainiotis, J. C. Lindenlaub, R. G. Marquart, and H. Schwarzlander Mar. 1, 1963 276 p 37 refs
(Contract AF 33(657)-7610)
(TR-EE 63-2)

Radio-wave channels are characterized by a model which accounts for both multiplicative and additive disturbances. A large amount of experimental data pertaining to radio disturbances is evaluated and correlated. The importance of the Rayleigh fading channel is emphasized, and previous work is extended to determine the capacity and efficiency of the Rayleigh channel. Detection-theory concepts have been extended to treat the problem of signal detection in the presence of statistically-unknown additive disturbances. Several detectors based on nonparametric statistical techniques are treated in detail. These detectors are compared to the conventional likelihood detectors. Design procedures are formulated. Signal-design techniques are used to optimize transmitted waveforms, and the improvement in system performance is determined. The criterion used in this analysis is the minimization of intersymbol influence and the minimization of transmitter power for a fixed probability of received errors. The tradeoffs available between transmitter power and coding complexity are thoroughly investigated for the binary symmetric channel. Results are obtained for both Hamming and Bose-Chandhuri codes. Author

N63-15368 Council for Scientific and Industrial Research, National Inst. for Telecommunications Research, Johannesburg (Union of S. Africa)
ANNUAL REPORT 1961-2 Special Report, 1 Apr. 1961 to 31 Mar. 1962
F. J. Hewitt 1962 35 p
(C.S.I.R. T-26)

Telecommunications research is reported in the following areas: (1) radio-wave propagation, including vertical-incidence ionospheric absorption and radio-noise levels below 30 mc/s; (2) natural phenomena, including radar observation of thunderstorms and the polarization of weather echoes; (3) advanced radio techniques, including tellurometer distance measurement, terrafix position measurement, and parametric amplifier and semiconductor

applications; and (4) radio and space research, including the Minitrack Station, the Deep Space Station, and the Mobile Tracking Station. M.P.G.

N63-15419 Radiation Incorporated, Melbourne, Fla.
MOLECULARIZED PCM TELEMETRY TRANSMITTING SET [Interim Technical Progress] Report No. 3, Dec. 15, 1962-Mar. 15, 1963
William A. Price Mar. 1963 59 p
(Contract AF 33(657)-9033)

The design of the required analog circuits for the selected PCM system is discussed in detail. The overall system block diagram and timing is presented as a basis for the better understanding of the design requirements. Author

N63-15425 Radiation Incorporated, Melbourne, Fla.
MOLECULARIZED PCM TELEMETRY TRANSMITTING SET Report No. 2, [Sept. 15-Dec. 15, 1962]
William A. Price Dec. 1962 79 p 2 refs
(Contract AF 33(657)-9033)

CONTENTS:

1. TECHNIQUES FOR TRANSMISSION OF PULSE CODE MODULATION SIGNALS D. D. Mc Rae p 57-79 (See N63-15426 08-12)

N63-15426 Radiation Incorporated, Melbourne, Fla.
TECHNIQUES FOR TRANSMISSION OF PULSE CODE MODULATION SIGNALS
D. D. Mc Rae Mar. 20, 1961 Presented at the Nat'l Telemetry Conf., Chicago, Ill., May 1961 *In its* Molecularized PCM Telemetry Transmitting Set Dec. 1962 15 p (See N63-15425 08-12)

Investigations for examining the capability of a pulse-code modulation system using simple minimum phase filters include: (1) the choice of the characteristics of the filter; (2) the determination of the relationship between spectral occupancy and the premodulation filter breakpoint; (3) the determination of the relationship between the infrared, video, and premodulation bandwidths; (4) plotting of the overall response of the three filters; i.e., the premodulation, infrared band-pass, and post-detection filters; and (5) the determination of the sensitivity as a function of the filter breakpoint by use of transient response. Results indicate that: (1) The transmission of binary pulse-code modulation signals can be achieved with good sensitivity and reasonable spectral occupancy by use of ordinary passive filters. (2) Very little difference exists between pulse-code modulation–frequency modulation, pulse-code modulation–phase modulation, and suppressed pulse-code modulation–amplitude modulation as long as the filters are properly adjusted. (3) Single sideband amplitude modulation reduces a spectral occupancy to one-half that available with other techniques whereas ordinary amplitude modulation suffers a 3 db disadvantage in sensitivity. (4) Pulse-code modulation–frequency modulation is a little easier to handle insofar as spectral occupancy is concerned since it requires only a third-order premodulation filter. I.v.L.

N63-15437 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.
SMALL SAMPLE SEQUENTIAL DETECTION
Robert Roy Boorstyn Apr. 1963 61 p 9 refs
(Grant AF-AFOSR-62-295)
(PIBMRI-1128-63)

Wald's sequential analysis has been applied by many to problems in statistical communications. Here, these techniques are extended to the class of applications requiring small sample size, for which the elegant results of Wald are inapplicable. The method for solution is discussed in detail and then applied to three examples, two of which are of extreme importance in communications work—the normal (Gaussian) and Rayleigh distributions. It is demonstrated that, even for very small average-sample sizes, a significant improvement is obtained. The results are then compared with those of other tests—the sequential test without memory (null-zone detection) and fixed sample-size tests. Remarks are included on truncation of sequential tests, after which is appended a summary of the relevant results of statistical hypothesis testing. Author

N63-15443 Coast Guard, Washington, D.C.
CWA REPORT OF AUTOMATIC LIFERAFT BEACON TEST, 23-24 MARCH 1962
Allen Winbeck Aug. 8, 1962 14 p

Automatic liferaft beacon tests are reviewed. Results indicate that: (1) Sweep widths of 200 miles and 100 miles are realized with the search aircraft at 40,000 feet and 20,000 feet, respectively. These sweep widths are calculated for any commercial or military aircraft capable of receiving very-high-frequency transmissions. Careful adjustment of the very-high-frequency receiver sensitivity aboard search and rescue aircraft can extend this sweep width to the horizon limits (up to 450 miles at 40,000 feet and 300 miles at 20,000 feet). (2) The characteristic wobbling tone of the beacon is a distinctive sound that is easily recognizable. This signal is not masked by other transmissions from nearby transmitters of greater power. (3) A very-high-frequency–automatic-direction-finder equipped aircraft can home effectively on the beacon signal. (4) Any aircraft equipped with a very-high-frequency receiver, including a very-high-frequency omnirange receiver, can locate the beacon using the "boxing in" method. (5) Horizon arcs can be swung to define the search area if signal-heard position, signal-lost position, and altitude reports from aircraft transisting the beacon signal area can be obtained. (6) The aircraft's antenna pattern will affect the equal distance fadeout points. I.v.L.

N63-15657 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
AN EVALUATION OF SPEECH COMPRESSION TECHNIQUES
Karl D. Kryter and Jay H. Ball Feb. 25, 1963 32 p refs
(Contract AF 30(602)-2235)
(BBN-978; RADC-TDR-63-90)

The results of previous technical reports, prepared under this contract, are summarized, and the results of tests of various recently developed speech compression systems are presented and analyzed. The results obtained from an analysis of published data and theory on techniques for the compression of the bandwidth of speech and new data can be summarized as follows: (a) Semivocoders, operating at 9600 bits/sec, and channel vocoders, at 2400 bits/sec, will provide speech of adequate intelligibility and quality for most military communications. The voice quality of semivocoders will usually be somewhat superior to that of the channel vocoders. (b) Results with as yet incomplete systems suggest that the Tarasoff-Daguet technique and the narrow-band spectrum sampling technique will ultimately provide speech intelligibility and quality comparable to that of the semivocoder. These systems will also require about 9600 bits/sec channel capacity during transmission. (c) Formant-tracking vocoders operating at about 1200 bits/sec can probably be developed to the point where they will provide speech intelligibility comparable to that from the channel vocoders operating at 2400 bits/sec. At the present time formant-tracking vocoders operating at 1000 bits/sec do not provide for adequate speech intelligibility. (d) Transmitting a restricted set of speech "patterns," from a larger set obtained from a digitized vocoder-type of speech analyzer-synthesizer, may provide a reduction in the information transmission rate normally required by that particular vocoder. Although this "pattern" matching technique is still in its early experimental stages, it appears that the normal bit rate for a given vocoder system may, by this technique, be reduced to ⅔ and possibly to ½ its normal magnitude. Author

09 ELECTRONICS

Includes: circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory.

For related information see: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N63-15669 Avco Corp. Research and Advanced Development Div., Wilmington, Mass.

NATURAL COMMUNICATIONS STUDY, PHASE I: FEASIBILITY STUDY ON A RELIABLE POLAR HF COMMUNICATIONS SYSTEM Technical Note No. 1

Geoffrey E. Hill, Sidney M. Bennett, and Claude J. Mazzola Apr. 22, 1963 133 p 65 refs

(Contract AF 30(602)-2809)

(RADC-TDR-63-112; RAD-TR-63-13)

In this report, the feasibility of obtaining reliable HF communications within and outside of polar regions, especially during disturbed conditions, is investigated. To establish methods by which propagation modes and field strength losses can be found, a number of formulations are developed. These are evaluated using vertical-incidence radio measurements. Also, some experimental data on a test propagation path are analyzed. The observed values are in excellent agreement with the expected ones. To understand the behavior of the ionosphere during both quiet and disturbed conditions, analysis is made of several ionospheric parameters. Analyses for a large number of disturbances in absorption, sporadic E, and F2-layer critical frequencies are given. Following these analyses, data on HF equipment and systems are presented, so that a basis for selection of equipment parameters is available. A computer program is then developed to determine the optimum routing of traffic after the traffic load and available channels have been found. Some examples are given. A completed system is presented for which the maximum possible reliability is found in an example situation. A traffic load is assigned to a hypothetical network during the height of a polar-cap absorption event. The results show that communication can be maintained during the event, but at a reduced level. Author

N63-15673 Aberdeen Proving Ground. Ballistic Research Labs., Md.

THE DESIGN OF COMMUNICATION SYSTEMS

Keats A. Pullen, Jr. Dec. 1962 123 p 36 refs

(BRL-1186)

The initial section of this report explores in considerable detail the more important limiting factors on free-space communications and shows how the effects of the various factors can be minimized. The remaining section applies the resulting discussion to typical problems to show how principles of communications theory and information engineering can be combined to develop improved methods of communication. Author

N63-15696 Page Communications Engineers, Inc., Washington, D.C.

SPACE COMMUNICATIONS TECHNIQUES Final Report

Apr. 1963 169 p 27 refs

(Contract AF 30(602)-2403)

(PCE-R-9854A; RADC-TDR-63-111)

This report describes the expansion of interim simplex space-communication facilities at Rome, N.Y., and Trinidad, to full duplex for use in communication experiments using passive satellites. Objectives of improved tracking accuracy and system gain were achieved by providing a conical scan feed and an optical tracking system at Rome, and new cooled, low-noise Doppler tracking receivers at both sites. Full duplex operation, deriving tracking information from received frequency while transmitting, and use of a highly sensitive receiving system in the same antenna with a megawatt-level-radar tracking system were found practical. Tracking accuracy of the improved system proved satisfactory. Recommended improvements in the communications baseband demodulator, Doppler-shift tracking, and passive radar tracking at Rome, N.Y., are discussed. Author

N63-15385 Rome Air Development Center. Techniques Lab., Griffiss AFB, N.Y.

ELECTRONICALLY SCANNED ANTENNA SYSTEMS

Moses A. Diab and Thomas Maggio Mar. 1963 21 p 13 refs Presented at 1962 Northeast Electronic Res. and Engr. Meeting, Boston, 5–7 Nov. 1962

(RAL-TM-63-5)

Research has been carried out over the past several years in the development of fixed antennas, scanned electronically. These techniques have the advantage of being able to scan at high speed, thereby performing many simultaneous functions and generating virtually unlimited amounts of power. This results from the fact that power is radiated simultaneously from thousands of relatively low-power elements. This report discusses the principle of electronic scanning as applied to phased-array radars, various approaches for achieving electronic scanning and some of their problems, and finally some applications to actual radar equipment. Author

N63-15449 Comitato Nazionale per l'Energia Nucleare. Laboratori Frascati (Italy)

APPARATO DIGITALIZZATORE DI AMPIEZZE CON USCITA IN STAMPA [AMPLITUDE DIGITIZING APPARATUS WITH PRINTOUT]

M. Coli, C. Dardini, A. Odian, and F. Pandarese Jan. 1, 1963 20 p In Italian

Uts Nota interna 180; LNF-63/1)

An apparatus, called an ELE-DIGO 162, has been constructed from an amplitude digitizing instrument and a memory counting instrument. The unit gives a luminous presentation of the data and a continuous printout. The apparatus can accept information from four separate channels of digitalization and can bind two columns into one for two ciphers of digitalization. The remaining three columns can be utilized for successive classification of the printout. Trans. by P.F.E.

N63-15480 Radio Corp. of America. RCA Labs., Princeton, N.J.

EVAPORATED THIN-FILM DEVICES Scientific Report No. 2, Dec. 1, 1962–Feb. 28, 1963

P. K. Weimer, H. Borkan, and F. V. Shallcross David Sarnoff Research Center, Mar. 10, 1963 35 p 6 refs

(Contract AF 19(628)-1617)

(AFCRL-62-67)

An improved electrode arrangement for the insulated-gate thin-film transistor has yielded higher performance and greater ease of fabrication. "On-to-off" current ratios of 10^7, input resistance exceeding 10^{10} ohms, and gain-bandwidth products of 25 megacycles have been obtained with polycrystalline cadmium sulfide films. By depositing all electrodes on top of the semiconductor, maximum freedom in processing the semiconductor layer is obtained. A novel type of field-effect diode is described. Author

N63-15492 Pennsylvania State U. Ionosphere Research Lab., University Park

ROCKET INSTRUMENTATION FOR THE MEASUREMENT OF AC CONDUCTIVITY, WITH A CAPACITIVE PROBE, AND LONG WAVE PROPAGATION IN THE LOWER IONOSPHERE

T. A. Seliga and R. W. Vogt [1963] 65 p 2 refs
(Contract AF 19(604)-8012)
(Sci. Rept. (E) No. 181; AFCRL-63-447)

The mechanical and electrical characteristics of instrumentation designed to be flown in a Black Brant Rocket are summarized. This instrumentation will be used for two experiments. One is an a.c. conductivity probe experiment; the probe measures the impedance between an insulated section of the nose cone and the body of the rocket at two different frequencies. The other is a propagation experiment for measuring the field strength of a low frequency wave transmitted from the ground to the rocket. J.A.J.

N63-15513 Diamond Ordnance Fuze Labs., Washington, D.C.
NUCLEAR RADIATION DAMAGE TO TRANSISTORS. VOLUME II: PERMANENT DAMAGE. PART I: THEORETICAL ASPECTS
Martin J. Cooper and M. Gay Payne June 28, 1962 25 p 14 refs
(TR-975, Sup. 1)

This paper presents a mathematical analysis of neutron damage to transistors. The approach involves statistical considerations of the variation of minority carrier lifetime τ, thereby providing a direct calculation of the damage factor K, previously considered an empirical constant. It is thus possible to calculate the change of common-emitter current gain (β) and collector leakage current (I_{CO}) due to neutron exposure. Calculations agree reasonably well with experimental observations. Author

N63-15537 Comitato Nazionale per l'Energia Nucleare Lab. Nazionali, Frascati (Italy)
UN CIRCUITO PER MISURARE L'ENERGIA MASSIMA DELLO SPETTRO DI BREMSSTRAHLUNG CUI SI RIFERISCE UN DETERMINATO EVENTO [A CIRCUIT FOR MEASURING THE MAXIMUM ENERGY OF THE BREMSSTRAHLUNG SPECTRUM WHICH IS RELATED TO A DETERMINED EVENT]
C. Dardini, C. Mencuccini, and V. Silvestrini Mar. 26, 1963 7 p 1 ref In Italian
(*Uts* Nota Interna 189; LNF-63/17)

The use of an electro-synchroton for measuring the maximum energy of the Bremsstrahlung spectrum is described. With the synchrotron used for the experiment, the maximum value of 1000 mev was reached in about 23 msec. Trans. by P.F.E.

N63-15538 Argonne National Lab., Ill.
HANDBOOK FOR THE NANOSECOND ELECTRON ACCELERATOR (NSEA)
Eugene A. Mroz, Warren L. Buck, Robert K. Swank, and H. Bruce Phillips Mar. 1963 140 p
(Contract W-31-109-eng-38)
(ANL-6700)

The apparatus for the study of scintillation decay times in the nanosecond region is described as a combination of three principal systems: a pulsed electron accelerator, a light detector, and a readout device. Theory of operation, the operating procedure, and maintenance instructions are summarized here. D.E.R.

N63-15559 Hanford Atomic Products Operation, Richland, Wash.
INVESTIGATION OF A POWER SPECTRUM ANALYZER FOR USE WITH RANDOM SIGNALS
J. F. Hauer and C. D. Swanson Apr. 25, 1963 39 p 9 refs
(Contract AT(45-1)-1350)
(HW-74783) OTS: $1.00

A power-density spectrum analyzer is described for use with the random neutron flux level signals that are generated in some typical zone of a reactor. The neutron flux level signals provide dynamic response information and also a comparative measure for monitoring long-term reactor power changes. The spectrum analyzer operates on principles of Fourier analysis and produces power-spectrum chart recordings directly on a logarithmically compressed and indexed scale. Trace variance, fidelity of spectrum contour, and the low frequency limit of analysis depend upon the sweep rate, frequency resolution, and data filtering. These parameters can be operationally tailored for the analysis of specific spectra with an accuracy within a few percent. M.P.G.

N63-15627 Polytechnic Inst. of Brooklyn, N.Y.
FEEDBACK DESIGN AND OPTIMAL CONTROL THEORY
John G. Truxal and Peter Dorato *In* Aeronautical Systems Div., Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11-13 Sept. 1962 Feb. 1963 p 1-9 12 refs (See N63-15626 12-01)

The optimization techniques of Pontryagin (maximum principle) and Bellman (dynamic programing) are evaluated as feedback design tools. The first part of the paper is devoted to a discussion of the advantages of optimal closed-loop (feedback) operation. The second part of the paper is devoted to an analysis of the feedback nature of the two optimization techniques cited and an analysis of the current computational difficulties in applying these techniques. Author

N63-15628 California U., Los Angeles
FUNCTION SPACE METHODS IN CONTROL SYSTEMS OPTIMIZATION
A. V. Balakrishnan and H. C. Hsieh *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11-13 Sept. 1962 Feb. 1963 p 10-40 6 refs (See N63-15626 12-01)

A procedure is introduced in mathematics for a class of deterministic control problems that uses methods of functional analysis which afford a general solution in many cases and a point of departure for problems where systematic analysis of a general nature is difficult. The computational method is that of steepest descent in Hilbert space. The problem is set for linear systems, linear dynamic systems, the computation method, the final value problem, and extension possibilities to nonlinear systems. D.E.R.

N63-15629 California U., Los Angeles
THE PROBLEM OF OPTIMAL MODE SWITCHING
R. A. Nesbit (Aerospace Corp., El Segundo) *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf. 11-13 Sept. 1962 p 41-54 20 refs (See N63-15626 12-01)

Control systems may be designed to operate in different modes. In some cases these modes may be switched to obtain various system trajectories. The optimization of the trajectories can be considered as a determination of the switching times and other mode parameters. The optimization problem is to determine these times and parameters. First-order computations can yield a descent method, but convergence is not assured. Theorems, which deal with the existence of solutions to optimal control problems, which have been recently proved indicate that it is better to relax the dynamic restrictions during the optimization than to work only with the admissible class of switched controls. The resulting optimal trajectory is then approximated by one of the trajectories from the admissible class. Author

N63-15631 Aeronautical Research Associates of Princeton, Inc., N.J.
THE SYNTHESIS OF OPTIMAL CONTROLLERS
Bernard H. Paiewonsky *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11-13 Sept. 1962 p 69-97 62 refs (See N63-15626 12-01)

An iterative procedure for the synthesis of time-optimal controllers is described and some experimental results are presented. The computational procedure described here is based on the idea of optimal evolution and uses the method of steepest descent to

obtain the proper values of the n − 1 parameters. The geometrical significance of these parameters as well as their relationship to the reachable sets is discussed. An experimental investigation of the convergence of the iterative procedure is described for both regulator and controller problems. The use of this iterative technique for variable input signals has been found to work in those cases investigated. The development of the theory shows that convergence to the correct solution cannot always be guaranteed when working with variable inputs. For example, it is possible for moving targets to "out run" or "out maneuver" the system. The results presented for the bang-bang problem were obtained on second-order systems. The rocket-steering problems provided third- and fourth-order examples. A closed-loop optimal controller for optimal rocket steering has been programed and is presently being studied on a digital computer. Author

N63-15632 Minneapolis-Honeywell Regulator Co. Military Products Group, Minn.

APPLICATIONS OF OPTIMIZATION THEORY. SECTION I— AN APPLICATION OF TIME-OPTICAL CONTROL THEORY TO LAUNCH VEHICLE REGULATION

F. B. Smith, Jr., and J. A. Lovingood (NASA, Marshall Space Flight Center, Huntsville, Ala.) *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11–13 Sept. 1962 p 99–118 9 refs (See N63-15626 12-01)

Section I considers the practical problem of closed-loop control of linear plants. A minimum response-time criterion is used in the design of a pitch-attitude controller for a flexible launch vehicle. The criterion is applied to a fourth-order model containing the primary dynamics of the thirteenth-order vehicle. There are tried and proven methods for obtaining the control variable as a function of time which takes the system from an initial condition to the target set in minimum time. It is shown that a suitable collection of these open-loop trajectories can be used to define a closed-loop control law. Results of an analog simulation are presented which show that this control law, properly applied to the flexible vehicle, results in good control. Section II considers finding the optimum path from an initial condition to a target set. The problem is reduced to an initial-value problem in which the minimizing initial values of the adjoint variables or multipliers are sought. (Inequality constraints are included in the formulation.) The problem then becomes one of minimizing a function of several variables subject to constraint equations in those variables. This is a problem for which necessary and sufficient conditions for a strong relative minimum are well known. A second-order Newton-Raphson iteration procedure for numerically finding the minimum is described. Experiences in the use of the Newton-Raphson method are described. Author

N63-15634 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

APPLICATION OF OPTIMAL LINEAR CONTROL THEORY TO THE DESIGN OF AEROSPACE VEHICLE CONTROL SYSTEMS

Philip A. Reynolds and Edmund G. Rynaski *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio, Proc. of the Optimum System Synthesis Conf., 11–13 Sept. 1962 p 159–188 4 refs (See N63-15626 12-01)

Optimal control techniques applied to the design of flight control systems are described. The theory of flight control and general applications are discussed along with two specific problems: (1) obtaining adequate lateral handling qualities in an X-15 type aircraft and (2) the attitude-control problem in large, flexible boosters. D.E.R.

N63-15636 DODCO, Inc., Blawenburg, N.J.

THE DOLIAC MACRO-MICRO CONTROL LOGIC, ITS SYNTHESIS, EVALUATION, POTENTIAL AND PROBLEMS

Daniel O. Dommasch *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11–13 Sept. 1962 p 241–267 11 refs (See N63-15626 12-01)

The acronym, DOLIAC, is formed from the first letters of the title, Dodco Optimum Limited Information Adaptive Controller. The term macro–micro signifies that both the overall guidance function (macro control) and the autopilot function (micro control) are accomplished within the same logical optimized system. The basic DOLIAC logic is obtained using either standard differential or variational calculus procedures, and both the necessary and sufficient conditions for solution existence are satisfied by the analysis (which is based on the use of an inequality boundary constraint on system action). It is demonstrated that the Lagrange multiplier acting on an inequality restraint performs the same function as the slack variable in linear programing analyses, and that the basic DOLIAC logic defines a simple nonlinear-gain switching system requiring error and error-rate data for its functioning. Although the nonlinearities of the DOLIAC logic are of an apparently simple sort, their nature precludes the definition of an equivalent linear system and, therefore, precludes the direct use of existing linear stability criteria for analysis. Whereas the analytic treatment of DOLIAC stability is incomplete, extensive numerical studies on both digital and analog computing equipment reveal, without question, the superiority of the nonlinear optimized logic over conventional linear-system performance in many cases. In other cases, the DOLIAC theory may be used to demonstrate that linear error and error-rate systems themselves form a degenerate class of optimum systems which, in these cases, may represent the only practical optimums obtainable. Author

N63-15637 New York U., N.Y.

THE APPROXIMATE REALIZATION OF OPTIMUM CONTROL SYSTEMS

S. S. L. Chang and F. J. Alexandro, Jr. *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11–13 Sept. 1962 p 269–322 8 refs (See N63-15626 12-01)

The paper describes two ways of approximate realization of Pontryagin and Bellman theories. The more sophisticated method involves combining the features of both theories and use of both digital and analog feedback. The less sophisticated, but more economical, method employs simple analog nonlinear elements. Both methods are applicable to high-order systems with random as well as deterministic inputs. A comparison of the limitations and similarities of the two methods are given. Author

N63-15638 Purdue U. Automatic Control Center, Lafayette, Ind.

APPLICATIONS AND APPLICABILITY OF OPTIMUM NONLINEAR CONTROL

Rufus Oldenburger *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11–13 Sept. 1962 p 323–341 10 refs (See N63-15626 12-01)

Much attention has been devoted in recent years to the problem of the optimum control of a system where the manipulated variable is subject to a saturation limitation. This is termed optimum nonlinear control. Much of the effort in this area belongs to the minimal-time school of Bellman, Pontryagin, and others. In 1944, the author began a theoretical and experimental study of optimum nonlinear control where it is desired to produce response that is best in every practical engineering sense. This work is discussed here, namely, the theory as far as appears practical for engineering applications, limitations on applicability, and examples of controllers patented and produced on the basis of the theory. Author

N63-15671 California U., Berkeley. Electronics Research Lab.
A FEW PROBABILISTIC PROPERTIES OF MODULAR CIRCUITS [Interim Report]
H. Kaneko. Apr. 30, 1962. 36 p. 12 refs
(Contract AF 19(604)-5466)
(Sci. Rept. No. 13; IER Ser. No. 60, Issue No. 448; AFCRL-62-939)
OTS: $1.25

Output probabilities of finite-state-machine elements are studied when the input of the machine elements is a random process. Delay element, modulo m adder and modulo m multiplier are considered as the machine elements. A new approach to the problem is made by defining the transformation matrices T and U_s for a modulo m adder and a modulo m multiplier, respectively. By using these matrices, the output probabilities of the machine and the stochastic matrix of the output are given in explicit expressions, assuming that the input process is a finite-state, time-invariant Markov process. A few examples of the combinatorial circuit of these elements are also studied. Author

N63-15674 Hanford Atomic Products Operation, Richland, Wash.
CIRCUITS FOR MANUAL ENTRY OF DATA INTO A MULTICHANNEL ANALYZER MEMORY
G. E. Driver. Apr. 25, 1963. 20 p
(Contract AT(45-1)-1350)
(HW-71044) OTS: $0.50

A device was developed to add digital data to pulse-height spectra information read out from Hanford's Whole-Body Counter. The pulse-height data are stored in a magnetic-core memory of a pulse-height analyzer. Pulse-height and digital data are entered into the Counter's memory unit through a keyboard similar to that of a five-column adding machine. Author

N63-15680 Hughes Aircraft Corp. Microwave Tube Div., Los Angeles, Calif.
SUPPORTING RESEARCH ON BEAM INTERACTION STRUCTURES FOR TRAVELING WAVE TUBES [Final Report, July 1960–June 1961]
A. W. Scott and R. D. Wanselow. Wright-Patterson AFB, Ohio, Electronic Technol. Lab., Jan. 1962. 167 p. 26 refs
(Contract AF 33(616)-7357)
(ASD-TR-61-277)

An inductively coupled cavity interaction structure is described which has cold bandwidth up to 60 percent at any peak power level from 500 watts to 500 kilowatts. Formulas are given for calculating the location and bandwidth of the fundamental passband, and interfering slot mode passband, and the experimental confirmation of these formulas is shown. The interaction impedance of this type of structure has been measured at bandwidths from 10 percent to 60 percent. Calculations of gain and efficiency based on these measurements show that this structure should provide good gain and efficiency as a traveling-wave amplifier over a 50 percent frequency bandwidth. Author

N63-15683 Cutler-Hammer, Inc. Airborne Instruments Lab., Deer Park, N.Y.
THIRD QUARTERLY PROGRESS REPORT ON SOLID-STATE CIRCUITS
S. Hamilton, W. W. Heinz, S. Okwit, E. W. Sard, and K. Siegel
(Contract AF 30(602)-2699)
(Rept. 1654-I-3; RADC-TDR-63-83)

Measurements of linewidth and anisotropy were made on a 600 $4\pi Ms$ Ga-YIG single-crystal ferrite. The linewidth behaved normally with respect to its variation with crystal axis orientation; that is, the linewidths were maximum (7.8 oersteds) with the external fields along the easy axis and minimum (3.7 oersteds) along the hard axis. Measurements on the decline of the susceptibility yielded critical threshold levels that agree well with the values predicted from the measured linewidths. It is expected that limiting levels in the region of −20 dbm should be realizable in the UHF region with this material. A low-threshold varactor limiter was designed and constructed using a varactor-loaded single-tuned circuit. By using the field buildup characteristic of a highly regenerative circuit, threshold-limiting levels of less than −20 dbm were achieved. Investigations of the performance of commercially available three-port C-band circulators, relative to the theoretical performance expected from Bosma's analysis, was continued. Modifications of Bosma's equations were made to allow for negative μ_{eff} values and extended frequency variation. An analysis of the input circuit of a one-port parametric amplifier (using a simplified series-equivalent circuit) was performed, from which phase shift versus frequency as a function of gain was obtained. Author

N63-15688 Electronic Communications, Inc., Timonium, Md.
UHF FERROELECTRIC PHASE SHIFTER RESEARCH Final Report
M. Cohn and A. F. Eikenberr. Apr. 30, 1962. 84 p. 19 refs
(Contract AF 19(604)-8379)
(AFCRL-62-319)

The analysis, construction, and performance of compact surface wave, ferroelectric phase shifters suitable for operation in the 100 to 1000-mc frequency range are described. Although this ferroelectric loaded parallel plane structure is a very low impedance structure, a satisfactory terminal impedance-matching technique has been devised. Kilovolt level voltages are needed, but since the current required to maintain or rapidly shift phase is low, the overall control-power requirements are at least an order of magnitude less than those for comparable ferrite phase shifters. One of these room-temperature-operable phase shifters provided 348° of phase shift and had an insertion loss which varied from 3.7 to 2.2 db at 207 mc and over a 0- to 4000-volt range of applied d.c. control voltage. Author

N63-15690 General Electric Co. Advanced Semiconductor Lab., Syracuse, N.Y.
APPLICATION OF TUNNELING TO ACTIVE DIODES Final Scientific Report No. 8b
N. Holonyak, Jr. May 31, 1962. 37 p. 19 refs
(Contract AF 19(604)-6623)
(AFCRL-62-522)

Experimental studies of double injection (DI) negative resistance phenomena in GaAs, Si, and Ge are described. The V-I characteristics, switching, trapping, and photosensitivity properties of GaAs DI diodes, fabricated by diffusion and alloying processes on semi-insulating crystals and in other cases via epitaxial processes, are presented. Similar studies and data are presented on Si DI diodes prepared via diffusion and alloying processes. Si diodes are described that are doped with various deep-level impurities and that, depending upon the kind and concentration of deep-level impurities, display a wide range of behavior including useful photosensitivity, switching, and voltage-regulation properties. The properties of Ge DI diodes are mentioned. A comparison is made between experimental results and current theories of double injection effects. In addition to the various practical implications, including possibilities for a noninteracting diode negative resistance matrix, the significance of deep-level doping and possible and actual effects on epitaxial Si devices is described. The use of DI phenomena for study of deep-level impurities and their properties is made apparent. Author

N63-15701 European Atomic Energy Community, Brussels (Belgium)
EINE SCHALTUNG ZUR SPEICHERUNG VON ZIFFERN AUF DEM STREIFEN-KARTEN-UMWANDLER IBM 047 (A WIRING FOR NUMBER STORAGE IN THE IBM 047 TAPE-TO-CARD PRINTING PUNCH)

H. H. Bernstein Joint Nuclear Res. Center, Ispra Estab. (Italy), Sci. Inform. Processing Center, Mar. 1963 12 p In German; English summary
(EUR-263.d) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86: 25 Belg. Fr.

Tape-to-card converters are normally not equipped with memorizing circuits. If certain information is to be punched later than it is read from the tape, a storage of this information is necessary. A solution for the storage of the numerals 1 to 9 is given. This solution can be generalized for the storage of all desired characters. An additional wiring for memorizing the numerals 1 to 7 containing 11 relays is given. The same problem is solved on the switchboard of this machine by using 17 selectors. Author

N63-15717 Naval Ordnance Lab. Research Dept., Corona, Calif.
PROPERTIES OF MINIATURIZED TUNNEL DIODE CIRCUITS AT MICROWAVE FREQUENCIES
R. W. Yancey Apr. 1, 1963 41 p 52 refs
(NAVWEPS-8144)

The state-of-the-art of semiconductor devices, especially tunnel diodes, is such that it is presently feasible to construct small, sensitive, low-power tuned RF microwave receivers up to, and including, K-band frequencies, using only semiconductors as the active elements. Such a receiver might use tunnel diodes as the RF amplifier and detector and a transistor as the video amplifier. Receiver circuits of this type are shown to operate with a noise figure on the order of 5 db at frequencies of 10 gc and above. Experiments indicate that tunnel-diode operation at higher frequencies is possible, but the tunnel diodes should be physically integrated into the microwave structures for practical operation at 35 gc. Author

N63-15738 Westinghouse Electric Corp., East Pittsburgh, Pa.
STUDY OF THE INTERACTION BETWEEN PHOTOCATHODES AND TARGET PLATES [Final Report, 16 Mar. 1959-15 Sept. 1960]
James A. Hall, Robert A. Shaffer, and Leo G. Bonney Wright-Patterson AFB, Ohio, Electronic Technology Lab., Feb. 1962 70 p
(Contract AF 33(616)-6422)
(ASD-TR-61-631)

Thin aluminum oxide films for storage target plates in image orthicons have been studied. These films are extremely rugged and adaptable to various modifications. Ruggedized tubes made using these films meet or exceed the 10g vibration tests of MIL-E-5272 with no image degradation. In standard 30-frame-per-second scanning systems, these Image Orthicons with S-10 photocathodes produced 100 T.V. line images with only 10^{-6}-foot candles incident on the photocathode. Tubes with multialkali S-20 photocathodes have produced 200 T.V. line images with 8.3×10^{-7}-foot candles on the photocathode. These tubes will store 600 line images for times longer than 10 seconds. Secondary emission gains of 6 were measured. Performance of these aluminum oxide storage targets compares exactly to that obtained in our tests of tubes with magnesium oxide target plates. Reasons for the substantial sensitivity improvement over glass target tubes are discussed. Author

10 FACILITIES

Includes: airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations.

For related information see: 06 Auxiliary Systems.

N63-15261 Bettis Atomic Power Lab., Westinghouse Electric Corp., Pittsburgh, Pa.
BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY
Mar. 1963 80 p 32 refs
(Contract AT(11-1)-GEN-14)
(WAPD-BT-28) OTS: $2.00

CONTENTS:

1. A NUMERICAL METHOD FOR THE DETERMINATION OF THE EFFECT OF PLANT CHARACTERISTICS ON CORE POWER TILT J. V. Reihing, Jr., and J. E. Funk p 1-20 1 ref (See N63-15262 12-23)
2. USE OF GADOLINIUM SEPTA IN SLAB CORES J. J. Kepes and J. A. Mitchell p 21-26 9 refs (See N63-15263 12-23)
3. SPACE AND TIME SYNTHESIS BY THE VARIATIONAL METHOD S. Kaplan and J. A. Bewick p 27-44 15 refs (See N63-15264 12-23)
4. THE DETERMINATION OF THE DENSITY OF CERAMIC FUEL WAFERS BY RADIATION METHODS H. H. Lang p 45-52 1 ref (See N63-15265 12-23)
5. THE THERMAL STABILITY OF TEFLON AND ITS COMPATIBILITY WITH AUSTENITIC STAINLESS STEEL AND OTHER STRUCTURAL MATERIALS R. E. Moore p 53-60 3 refs (See N63-15266 12-19)
6. A VERIFICATION OF METHODS FOR ANALYZING STRESSES AND DEFLECTIONS IN PERFORATED MATERIALS AND AN EVALUATION OF ROLLED-IN TUBE EFFECTS W. J. O'Donnell p 61-76 3 refs (See N63-15267 12-33)

N63-15339 General Motors Corp. Defense Research Labs., Santa Barbara, Calif.
HIGH VELOCITY GUNS FOR FREE-FLIGHT RANGES
A. C. Charters and John S. Curtis [1962] 75 p 12 refs Presented at the AGARD Specialists' Meeting on High Temperature Aspects of Hypersonic Flow, Rhode-St.-Genese, Belgium, Apr. 3-6, 1962
(TM62-207)

Free-flight ranges have been modified for research in high velocity flight. Tests can be carried out under the conditions of reentry of missiles and spacecraft. Instruments have been devised for recording the optical radiation, the ionization, and other features of reentry flight. Guns have been developed which will fire aerodynamic models at the velocities of full-scale flight. A study of gun performance suggests that the highest velocities in firing aerodynamic models will be produced by a gun which accelerates the model with a constant force throughout the firing run. The accelerated-reservoir light-gas (AR-LG) gun appears to fire models with this constant acceleration performance. An AR-LG gun at the Flight Physics Laboratory has fired a saboted glass sphere at a velocity of 26,800 feet per second and a solid plastic cylinder at a velocity of 32,800 feet per second. In both of these categories, it is believed that these velocities are the highest reached with guns up to the present time. Author

N63-15345 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A 6-INCH SUBSONIC HIGH-TEMPERATURE ARC TUNNEL FOR STRUCTURES AND MATERIAL TESTS
Ronald D. Brown and L. Ross Levin Washington, NASA, Apr. 1963 33 p 13 refs
(NASA TN D-1621) OTS: $1.00

A subsonic arc tunnel utilizing three-phase a.c. water-cooled copper electrodes has been developed at Langley Research Center to evaluate materials under simulated reentry conditions. The tunnel is capable of producing a range of stagnation pressures from 0.16 to 1.0 atmospheres and stagnation temperatures up to 4400° K for periods of time up to 90 seconds. Heat-transfer rates up to 70 Btu/ft^2-sec. can be obtained on a 3-inch-diameter flat-face body in the 6-inch-diameter stream. Ablation materials can

be evaluated in the stream at stagnation enthalpies up to 4000 Btu/lb. Three commercially available materials, Teflon, nylon, and Fluorogreen, were tested as ablation materials in the 6-inch subsonic arc tunnel, and the results are in reasonable agreement with theoretical predictions and previously published experimental data. Author

N63-15367 Burroughs Corp., Paoli, Pa.

DYNAMIC TASK SCHEDULING IN FLIGHT SIMULATORS [Final Report]

Jerome M. Kurtzberg Wright-Patterson AFB, Ohio. Behavioral Sciences Lab., Feb. 1963 49 p 13 refs

(Contract AF 33(616)-8062)

(AMRL-TDR-63-17) OTS: $1.50

Attention is focused on the possible application of some of the heuristic programing techniques, and an evaluation of their worth for that specific purpose is made. Two main applications for a task-sequencer are defined. The first involves the traditional training of students (flight crews) for flight-vehicle operation, termed the operation-teaching mode. The second is for the development of tactical skill, i.e., crew decision-making capabilities, termed the tactic-teaching mode. Algorithms for task sequencing in real time are formulated for both of these classes of applications. Author

N63-15376 General Dynamics/Fort Worth, Tex.

ARC-HEATED HYPERTHERMAL RESEARCH FACILITY

Oct. 1, 1962 38 p 9 refs

(AT-7)

This document describes the design and performance of a 1.8-megawatt arc-heated hypersonic wind tunnel, designated the Hyperthermal Research Facility (HRF) which is currently in operation at General Dynamics in Fort Worth. Basically, this facility is a high enthalpy (18,000 Btu/lb), free jet, supersonic–hypersonic wind tunnel which uses gases such as air, nitrogen, argon, etc., as the primary working fluid. The gas is heated in a magnetically stabilized electric-arc plasma generator, expanded through an axisymmetric nozzle into a free-jet test section and exhausted through a diffuser, cooling section, and steam-jet ejector system. Water-cooled copper electrodes are used in the plasma generator to reduce the contamination in the test stream. The HRF is ideally suited for simultaneously producing the majority of heating rates and stream total enthalpies encountered by ICBM, satellite, and superorbital atmospheric reentry vehicles. Author

N63-15395 Federal Aviation Agency. Aviation Research and Development Service, Atlantic City, N.J.

INVESTIGATION OF CHARACTERISTICS OF THE PENTAGONAL TOWER CAB Final Report

T. H. Green Feb. 1963 152 p 12 refs

CONTENTS:

1. MATHEMATICAL FORMULA FOR DETERMINING THE HEIGHT REFLECTIONS LOCATED BETWEEN CORNERS J. R. V. Veer p 65–66
2. MATHEMATICAL FORMULA FOR DETERMINING THE AREA OF CORNER REFLECTIONS p 67–71
3. SURVEY AND REPORT OF LIGHT TRANSMISSION AND REFLECTION CONSIDERATIONS FOR AIR TRAFFIC CONTROL TOWER CAB DESIGN Final Report L. W. Hornfeck 30 p 2 refs (See N63-15396 12-10)
4. QUESTIONNAIRE GIVEN TO CONTROLLER SUBJECTS 32 p

N63-15396 Federal Aviation Agency. Aviation Research and Development Service, Atlantic City, N.J.

SURVEY AND REPORT OF LIGHT TRANSMISSION AND REFLECTION CONSIDERATIONS FOR AIR TRAFFIC CONTROL TOWER CAB DESIGN (Final Report)

Lawrence W. Hornfeck, ed. Sept. 1962 *In its* Investigation of Characteristics of the Pentagonal Tower Cab Feb. 1963 30 p 2 refs Prepared under contract (See N63-15395 12-10)

(Contract FAA/SRDS-N3-12)

The National Aviation Facilities Experimental Center, Atlantic City, New Jersey, is conducting experiments with a pentagonal-shaped Air Traffic Control Tower Cab. The purpose of this report is to present an analysis of the cab design as related to the visual functions required. In particular, such items as type, tint and slope of window glass, light transmission and reflection through and within the cab, and instrumentation for illumination comparisons are considered. Author

N63-15410 General Electric Co. Knolls Atomic Power Lab., Schenectady, N.Y.

THE SPACE-TIME NEUTRON KINETICS BY A VARIATIONAL METHOD WITH APPLICATION TO POWER REACTOR DYNAMICS

D. E. Dougherty Dec. 26, 1962 71 p 34 refs

(Contract W-31-109-eng-52)

(KAPL-2217) OTS: $2.00

By use of the semidirect variational method, the time- and space-dependent neutron kinetic equations have been reduced to a system of integro-differential equations in the time domain. The state vector of these equations defines the time-dependent coefficients for a set of space modes given by a modal expansion of the neutron flux. The accuracy of this method of analysis is arbitrary, and solutions are available for reactor configurations as complex as the present state-of-the-art allows steady-state determinations. Author

N63-15539 Naval Radiological Defense Lab., San Francisco, Calif.

HYDRA PROGRAM. THE NRDL LOW-YIELD UNDERWATER EXPLOSION TANK AND ASSOCIATED INSTRUMENTATION

R. R. Buntzen Feb. 18, 1963 19 p 5 refs

(USNRDL-TR-623)

A facility was designed and constructed to simulate underwater nuclear explosions on a very small scale by employing a submerged exploding wire in a contained environment. This facility is a laboratory complement to the NRDL Hydra Program. The variable-pressure explosion tank and related mechanical features are described. Development of the energy storage system, trigger, and discharge circuit for the submerged exploding wire are discussed. The instrumentation needed to determine the explosion yield and the results for a 25-kv discharge are given. Author

N63-15541 Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho

A PYROLYTIC CAPSULE DESIGN FOR FILM FORMATION STUDIES

E. Burroughs, S. Cohen, and W. B. Lewis AEC National Reactor Testing Station, Mar. 15, 1963 23 p

(Contract AT(10-1)-205)

(IDO-16845) OTS: $0.50

The Pyrolytic Capsule Fouling Test (PCFT) apparatus was built to study organic film formation on a heated surface under gamma irradiation. The preliminary testing of the capsule and auxiliary equipment indicated that film-formation studies could be made with the apparatus under closely controlled conditions, with or without gamma irradiation. In addition, the capsule was useful for heat-transfer studies. Author

N63-15550 Los Alamos Scientific Lab., N. Mex.

FAST ELECTROMAGNETIC SIGNALS PRODUCED BY NUCLEAR EXPLOSIONS IN THE TROPOSPHERE

J. Karl Theobald Apr. 11, 1963 18 p 2 refs

(Contract W-7405-eng-36)

(LA-2808)

Observations during the Pacific tests in the summer of 1962 confirm the presence of high-frequency components of the electromagnetic signal, which vary in polarity according to the eastern or western location of the recording station from the detonation point. The interaction of relativistic Compton electrons produced by the gamma rays from the detonation with the geomagnetic field is discussed and shown to be capable of producing the signals observed. Author

N63-15562 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

MOVING-COCKPIT-SIMULATOR STUDY OF PILOTED ENTRIES INTO THE EARTH'S ATMOSPHERE FOR A CAPSULE-TYPE VEHICLE AT PARABOLIC VELOCITY

John W. Young and Lawrence E. Barker, Jr. Washington, NASA, May 1963 11 p 1 ref
(NASA TN D-1797) OTS: $0.50

A description is presented of a moving-cockpit-simulator study relating to entry guidance for a low-lift-drag-ratio vehicle entering the earth's atmosphere at parabolic velocity. The primary goal of this study was to determine the effect of angular motions on the ability of the pilot to perform the maneuvers required during supercircular entry, and to compare the pilot's performance on the moving simulator with that obtained from similar entries on a fixed-base simulator. Consideration was also given to the development of a minimum instrument display for which the pilot used motion cues to aid him in performing the entry maneuvers. The study established a pilot preference for the moving simulator rather than a fixed-base simulator. Author

N63-15563 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A PRELIMINARY STUDY OF HANDLING-QUALITIES REQUIREMENTS OF SUPERSONIC TRANSPORTS IN HIGH-SPEED CRUISING FLIGHT USING PILOTED SIMULATORS

Maurice D. White, Richard F. Vomaske, Walter E. Mc Neill, and George E. Cooper Washington, NASA, May 1963 31 p 13 refs
(NASA TN D-1888) OTS: $0.75

Two different simulators were used in a piloted motion simulator study to obtain preliminary handling-qualities data on a supersonic transport in cruising flight at a Mach number of 3.0. Results indicate that, for configurations currently being considered for the supersonic transport, augmentation of the rotational damping characteristics is likely to be required around all three axes, the greatest increment being required for the yaw axis. The static stability characteristics, however, appear to require less augmentation than the damping characteristics. The problem of limiting the sideslip excursions following abrupt loss of thrust of an outboard podded engine contributed greatly to the requirements for directional damping and stability. The satisfactory handling-qualities characteristics defined for a transport airplane by this study differ from those defined in previous studies of fighter-type airplanes, and indicate a need for a separate appraisal of transport handling-qualities requirements. Accurate appraisal of the effects of large disturbances of the airplane requires simulator capabilities that reproduce translational as well as rotational motions. Author

N63-15601 Douglas Aircraft Co., Inc. Missile and Space Systems Div., Santa Monica, Calif.

RESULTS OF INDEPENDENT RESEARCH AND DEVELOPMENT STUDIES BY THE DOUGLAS AEROPHYSICS LABORATORY STAFF IN LIQUID MECHANICS AND SIMULATION TECHNIQUES, FISCAL YEAR 1962

W. E. Smith, ed. Jan. 1, 1963 184 p 66 refs
(SM-41379)

CONTENTS:

1. EXPERIMENTAL WORK ON TRANSITION AT HYPERSONIC SPEEDS R. E. Deem 16 p 6 refs (See N63-15602 12-11)
2. HYPERSONIC TURBULENT HEAT TRANSFER R. E. Deem 21 p 6 refs (See N63-15603 12-13)
3. HYPERVELOCITY STUDIES USING HYPERVELOCITY IMPULSE TUNNEL J.A. Cooper 26 p 18 refs (See N63-15604 12-26)
4. HYPERVELOCITY STUDIES USING LIGHT GAS GUN AND BALLISTIC RANGE W. B. Covey 45 p 16 refs (See N63-15605 12-10)
5. TRANSONIC TEST SECTION STUDIES J. F. L. Aldrich 1 p 2 refs (See N63-15606 12-10)
6. WIND TUNNEL INVESTIGATIONS OF A 1/16 SCALE MODEL OF THE PROPOSED ANNULAR STEAM EJECTOR FOR THE TRISONIC FOUR-FOOT WIND TUNNEL W. V. Speaker 35 p 6 refs (See N63-15607 12-10)
7. HYPERSONIC WIND TUNNEL INSTRUMENTATION STUDIES E. R. Burnop 6 p 7 refs (See N63-15608 12-10)
8. FLOW INVESTIGATIONS IN THE HYPERSONIC WIND TUNNEL R. M. Cole 16 p 2 refs (See N63-15609 12-10)
9. OPTICAL FLOW VISUALIZATION INSTRUMENTATION W. A. Stolzenburg 13 p 3 refs (See N63-15610 12-10)

N63-15605 Douglas Aircraft Co., Inc. Missile and Space Systems Div., Santa Monica, Calif.

HYPERVELOCITY STUDIES USING LIGHT GAS GUN AND BALLISTIC RANGE

W. B. Covey *In its* Results of Independent Research and Development Studies by the Douglas Aerophysics Laboratory Staff in Fluid Mechanics and Simulation Techniques, Fiscal Year 1962 Jan. 1, 1963 45 p 16 refs (See N63-15601 12-10)
(SM-41379-4)

A two-stage light-gas gun and 100-foot ballistic range are in an early stage of development and operation at DAL. Principles of design and operation are reported in support of the proposed limits of performance, viz., 15,000 ft/sec from a single-stage gun of 1.5-inch bore and 30,000 ft/sec from a two-stage gun of 0.25-inch bore. Several types of initial experiments have been performed. For example, 50-gram models have been launched from the single-stage gun at velocities ranging up to 15,000 ft/sec. Instrumentation systems, with emphasis on telemetry, are in an early developmental stage. Encapsulated, microminiature, telemetry carrier oscillator circuits, 0.5-inch diameter by 1.1-inch long, have been built, and transmit at frequencies to 80 megacycles. It is estimated that 3 to 7 channels of pressure or temperature information can be telemetered from a model by frequency modulation of a 110-megacycle carrier. Author

N63-15606 Douglas Aircraft Co., Inc. Missile and Space Systems Div., Santa Monica, Calif.

TRANSONIC TEST SECTION STUDIES

J. F. L. Aldrich *In its* Results of Independent Research and Development Studies by the Douglas Aerophysics Laboratory Staff in Fluid Mechanics and Simulation Techniques, Fiscal Year 1962 Jan. 1, 1963 1 p 2 refs (See N63-15601 12-10)
(SM-41379-5)

The Trisonic Four-Foot Wind Tunnel acquired a transonic testing capability during FY 1962. Whereas the supersonic test section provides for Mach 1.4 to 5, the transonic test section provides for Mach 0.2 to 1.3. An IR&D study of the transonic flow was initiated and completed during this year, primarily to examine flow quality and to calibrate the test section for Mach number distribution and flow inclination. Results are reported in detail in references 1 and 2. Across the 54-inch window region, the Mach number varies ± 0.0075 at subsonic speeds and ± 0.010 at supersonic speeds. Furthermore, the average Mach number in this region can be determined within ± 0.003 by appropriate reduction of a routine measurement of pitot pressure. The boundary-layer displacement thickness on the perforated walls at zero incidence decreases from 0.5 inch at Mach 0.8 to a minimum of 0.17 inch at

about Mach 0.95, increases to a maximum of 0.28 inch at Mach 1.1, and decreases at higher speeds. Transonic flow vectors coincide with the centerline but tend to diverge at other locations. For example, the vertical flow divergence one foot above the centerline is 0.5 degree at subsonic speeds and diminishes at supersonic speeds to zero at Mach 1.2. The flow-divergence change per unit distance from the tunnel centerline in the horizontal plane is nearly twice that in the vertical plane, probably due to the lateral position of Mach number control valves. The calibration shows, in general, that acceptable flow properties and uniformity are generated at transonic speeds. Author

N63-15607 Douglas Aircraft Co., Inc. Missile and Space Systems Div., Santa Monica, Calif.

WIND TUNNEL INVESTIGATIONS OF A 1/16 SCALE MODEL OF THE PROPOSED ANNULAR STEAM EJECTOR FOR THE TRISONIC FOUR-FOOT WIND TUNNEL

Ward V. Speaker *In its* Results of Independent Research and Development Studies by the Douglas Aerophysics Laboratory Staff in Fluid Mechanics and Simulation Techniques, Fiscal Year 1962 Jan. 1, 1963 35 p 6 refs (See N63-15601 12-10)
(SM-41379-6)

An annular steam ejector has been investigated to determine an acceptable configuration for use in a proposed ejector system for the Trisonic Four-Foot Wind Tunnel. Configurations analyzed and tested on 1/16 scale include combinations of two ejector exit areas, eight ratios of mixing tube length-to-diameter, and two contraction geometries within the mixing tube, all in the presence or absence of a scale model of the existing subsonic diffuser of the subject wind tunnel. Mach number in the ejector and stagnation pressure in the ejector and in the wind tunnel were varied. Wind tunnel Mach number was 4.0. Pressure data from all the configurations were reduced and analyzed to determine the effects of ejector and mixing tube geometry on performance of the system. Minimum length/diameter ratios, minimum operating tunnel pressures, and minimum steam mass flows have been determined, and preliminary judgments have been made which would apply also if air were used as the ejector motive medium in place of steam. Reductions of starting and running pressures by factors as great as 3.3 have been achieved experimentally. However, it is concluded that the configuration of the existing subsonic diffuser would be unacceptable as an element of the ultimate mixing tube, and that a contraction downstream of a constant-area mixing tube may be unnecessary in an optimum system. Author

N63-15608 Douglas Aircraft Co., Inc. Missile and Space Systems Div., Santa Monica, Calif.

HYPERSONIC WIND TUNNEL INSTRUMENTATION STUDIES

E. R. Burnop *In its* Results of Independent Research and Development Studies by the Douglas Aerophysics Laboratory Staff in Fluid Mechanics and Simulation Techniques, Fiscal Year 1962 Jan. 1, 1963 6 p 7 refs (See N63-15601 12-10)
(SM-41379-7)

Five major areas of instrumentation have been investigated, all pertaining especially to the Hypersonic Two-Foot Wind Tunnel but with certain advantages accruing to the entire family of three intermittent wind tunnels at DAL. First, analysis of pressure lag time in capillaries and experience with variable reluctance transducers and with the 160-channel pressure scanner in the trisonic tunnels have led to detailed plans for a system of measuring accurately 70 model pressures at four or more model attitudes at all operable conditions of the Hypersonic Tunnel. Second, electrode materials and configurations have been successfully devised for repeated operation of light sources for shadowgraphs and other optical systems which adhere to the specifications appropriate to Hypersonic Tunnel tests. Third, a reliable six-component strain-gage balance has been developed and tested in the three wind tunnels to the extent that the new balances for special models can now be produced for less than one-third of the cost of commercially obtainable balances. This device has contributed to the successes of the large number of programs performed in DAL facilities. An acceleration-compensated, three-component balance system also has been developed, which utilizes solid-state strain gages to realize improvements in sensitivity measured by orders of magnitude. Fourth, high-temperature-measurement procedures, i.e., for temperatures beyond the capabilities of conventional thermocouples, have been studied and operational techniques have benefitted therefrom. Fifth, the precision of the central data-gathering system has been improved so that errors transmitted due to internal noise are limited to 10 microvolts and those due to external electrical fields do not exceed 12 microvolts—satisfactory levels for the foreseeable future. Author

N63-15609 Douglas Aircraft Co., Inc. Missile and Space Systems Div., Santa Monica, Calif.

FLOW INVESTIGATIONS IN THE HYPERSONIC WIND TUNNEL

R. M. Cole *In its* Results of Independent Research and Development Studies by the Douglas Aerophysics Laboratory Staff in Fluid Mechanics and Simulation Techniques, Fiscal Year 1962 Jan. 1, 1963 16 p 2 refs (See N63-15601 12-10)
(SM-41379-8)

Early operation of the hypersonic two-foot wind tunnel had been hampered by oblique shock waves which originate at the exit of the contoured nozzle and limit the size of the usable core within the free jet of test air issuing therefrom. Several modifications to the configuration of the scoop which collects this free jet, and to the geometry of strut and pod of the model support system, have been tested. One such configuration produced shock-free flow within the 30-inch window region when the model and pod are translated outside the test section. The greatest improvement, however, results from reducing the wedge angle of the pod, sharpening its leading edge, and properly sealing clearances between strut and scoop. Author

N63-15610 Douglas Aircraft Co., Inc. Missile and Space Systems Div., Santa Monica, Calif.

OPTICAL FLOW VISUALIZATION INSTRUMENTATION

W. A. Stolzenburg *In its* Results of Independent Research and Development Studies by the Douglas Aerophysics Laboratory Staff in Fluid Mechanics and Simulation Techniques, Fiscal Year 1962 Jan. 1, 1963 13 p 3 refs (See N63-15601 12-10)
(SM-41379-9)

Progress is recorded in three areas of optical flow visualization techniques for intermittent wind tunnels: front lighting, quantitative color schlieren, and glow-discharge visualization. A front lighting system of flashbulbs has been satisfactorily devised whose photographic exposure is well balanced with the existing schlieren system. Substitution of photofloods for the flashbulbs has been less satisfactory from the optical viewpoint. However, this technique can be improved by replacing the predominantly red photoflood with a blue light source to match the blue schlieren light and to adapt to the standard, blue-sensitive film. A satisfactory trichromatic filter for quantitative color schlieren is not yet available, but some success has been achieved with combinations of broad band color filters, which essentially produce a panchromatic image, and with combinations of interference line filters, which essentially produce a trichromatic image. A charged probe has been designed and installed adjacent to a specially constructed model for glow-discharge visualization in the Hypersonic Two-Foot Wind Tunnel. However, the few tests of this technique have so far been inconclusive. Author

N63-15613 FluiDyne Engineering Corp., Minneapolis, Minn.
HYPERSONIC TEST STAND MODEL INSTRUMENTATION SYSTEM
Charles Christopherson, William Hamre, Taro Matsuura, and John Wastvedt Wright-Patterson AFB, Ohio, Aeronautical Res. Labs., Jan. 1963 35 p
(Contract AF 33(616)-7543)
(ARL 63-1)

The model instrumentation for the Mach-14 Hypersonic Test Stand was developed to provide a means for supporting the articles in the test stand flow environment, varying the orientation of the test article with respect to the flow environment, and obtaining data on the force, pressure, and temperature loads to which the test article is exposed in the flow environment. Author

N63-15725 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
A SIMULATOR STUDY OF TILT-WING HANDLING QUALITIES [Technical Report, June 1960-May 1962]
Harry T. Breul Mar. 1963 99 p 18 refs
(Contract NOw-60-0396-c)
(RE-162)

An experimental investigation was performed to study handling qualities of tilt-wing type VTOL aircraft. A flight simulator consisting of a cockpit free to pitch and roll, and an optical display system providing a visual illusion of motion in the remaining four degrees of freedom were employed in this program. Qualified pilots operated both a longitudinal three degree of freedom and a six degree of freedom mechanization of a simulated 15,000-pound tilt-wing type VTOL airplane. Four pilots evaluated over 350 configurations at hover and during continuous transitions in calm air and under visual flying conditions. Transition handling qualities are discussed, primarily with regard to whether satisfaction of hover-derived criteria are sufficient to ensure good handling qualities for the performance of the transition maneuver. That is, "Do handling qualities remain acceptable during a transition maneuver if rate damping and control sensitivity, which are allowed to vary in typical fashion, always remain within the acceptable hover boundaries?" Several parameters unique to VTOL designs (e.g., wing tilt rate) are also discussed in light of their effects on transition handling qualities. The critical result here is that handling qualities criteria derived from hover or steady flight experimentation cannot, in general, be stretched to include nonsteady (e.g., transition) flight. Author

N63-15758 Defense Research Chemical Labs., Ottawa (Canada)
GAMMA SHIELDING PROVIDED BY DUCTS
C. E. Clifford Ottawa, Defence Res. Board, May 1962 20 p 11 refs
(DRCL Rept. 370; AD 282-393)

Dose distributions have been measured in 8-in., 12-in., and 3-foot-wide ducts exposed to an off-axis source of 0.66 mev γ's (Cs^{137}). In the main ducts, scattered radiation from surfaces not exposed to the incident radiation accounted for at least 25% of the total dose. The variation of the dose due to radiation scattered from the exposed areas was compared with the calculated distributions obtained using various assumptions about the angular differential scatter of radiation. The additional dose reduction provided by side ducts was less than the solid-angle fraction subtended by the entrance of the side ducts and varied with their location along the main duct. Author

11 FLUID MECHANICS

Includes: boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow, 03 Aerodynamics of Wings and Control Surfaces; 13 Heat Transfer; and 24 Physics, Plasma.

N63-15319 California U., Berkeley. Lawrence Radiation Lab.
STABLE-FLOW FREE-BOUNDARY MIGRATION AND FRACTIONATION OF CELL MIXTURES: SEDIMENTATION AND ELECTROPHOPHORESIS
Howard C. Mel Jan. 23, 1963 80 p 64 refs
(Contract W-7405-eng-48)
(UCRL-10640) OTS: $2.00

A number of analytical and preparative problems of complex biological mixtures, requiring speed and mildness of handling, large capacity, and high resolution, can be advantageously attacked by the stable-flow free boundary (STAFLO) method. Experimental and theoretical aspects of STAFLO migration, fractionation, and concentration are analyzed, with particular reference to cell mixtures. Combination gradient profiles of composition, conductivity, pH, etc., can be established almost arbitrarily in a steady-state manner, without the usual gradient mixing devices. The solution to the basic problem of stabilizing flows, without the use of an anticonvective supporting medium, is discussed in detail. Migration principles, especially for sedimentation and electrophoresis are classified as rate, or equilibrium, and the known and unknown elements of several are examined. Author

N63-15323 National Aeronautics and Space Administration. Washington, D.C.
ON THE FLOW STRUCTURE WITHIN A CONSTANT PRESSURE COMPRESSIBLE TURBULENT JET MIXING REGION
W. L. Chow and H. H. Korst (Illinois U.) Apr. 1963 33 p 11 refs
(NASA Grant NsG-13-59)
(NASA TN D-1894) OTS: $1.00

Results are presented from the numerical calculations carried out to produce detailed information on the kinematic, dynamic, dissipative, and thermodynamic characteristics of a uniform half-infinite stream, mixing with a quiescent fluid of the same composition. An effective Prandtl number of $Pr_t = 1$ is assumed for the constant pressure, nonisoenergetic turbulent mixing process. The ratio of specific heat becomes absorbed by selecting Crocco number instead of Mach number as measure for the compressibility, thus allowing generalization of the results to any perfect nonreacting gas having constant specific heat. After identifying a functional form for the streamwise component of the velocity profile, a single empirical mixing parameter becomes well defined and can be absorbed in a rational presentation of structural details of jet mixing regions, such as the vertical-velocity component, temperature and density distribution, integrals describing flow of mass, momentum, mechanical energy, the transfer of shear work and heat across individual streamlines, as well as local and integrated dissipation rates for mechanical energy. Author

N63-15326 German-French Research Inst., Saint-Louis (France)
METHODES ET RESULTATS D'ETUDE D'ECOULEMENTS HYPERSONIQUES CHAUDS PAR DES MOYENS EXTERIEURS A L'ECOULEMENT [METHODS AND RESULTS OF STUDY OF HEATED HYPERSONIC FLOWS BY MEANS EXTERIOR TO THE FLOW]
André Auriol [1962] 10 p 16 refs Presented at the AGARD Congress at Rhode-St.-Genèse, Apr. 3-6, 1962 In French

A heated hypersonic wave is usually studied by the direct method of inserting an instrument to measure pressure, temperature, or wave effects into the wave, but this sometimes is difficult to accomplish. This study outlines methods and results of visual or other exterior means of studying these waves, such as direct observation, study of the luminous emissions of the wake, and the use of wave models to study the Doppler effect and the degree of ionization. Trans. by D.E.R.

N63-15334 Princeton U. Frick Chemical Lab., N.J.
THE STRUCTURE OF SHOCK FRONTS IN ARGON AND NITROGEN Technical Report No. 6
Donald F. Hornig and Melvin Linzer (Ph. D. Thesis) Apr. 1, 1963 39 p 19 refs
(Contract Nonr-1858(24))

The optical reflectivity method was used to investigate the structure of shock fronts in argon from Mach 1.70 to Mach 4.85 and in nitrogen from Mach 2.01 to Mach 3.72. Experimental data were obtained at two wavelengths and over a wide range of initial pressures. The reflectivities, corrected empirically for shock curvature, were fitted to a bimodal profile to yield a maximum-slope density thickness. The reciprocal of the thickness in argon (expressed in terms of the Maxwellian mean free path in the undisturbed gas) rises rapidly to a maximum of approximately 0.31 at about Mach 3.5 and decreases gradually thereafter. Above Mach 3 the thickness is about 50% greater than calculated from the Navier-Stokes equations, using a realistic viscosity-temperature relationship. There is excellent agreement, especially at the higher shock strengths, with recent bimodal calculations carried out by Muckenfuss, using realistic intermolecular potentials. In nitrogen, the shocks are thinner than in argon and appear to attain a minimum value of 2.5 initial mean free paths at about Mach 3.7. Rotational relaxation appears to be as rapid in the strong shocks as previously observed in weak shocks; it appears to be completed within the shock front. The experimental density thicknesses are approximately 50% greater than those calculated from the Navier-Stokes equations, using experimental shear viscosity μ and a bulk viscosity of $2\mu/3$. The agreement with these Navier-Stokes solutions is about as good as those in argon. Author

N63-15337 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux

PROBLEMES D'INTERPRETATION DES RESULTATS DE MESURES DANS UNE SOUFFLERIE A ARC PROBLEMS IN INTERPRETATION OF RESULTS OF MEASUREMENTS IN AN ARC WIND TUNNEL

J. P. Chevallier and F. Bouniol [1962] 25 p 8 refs In French Presented at AGARD Specialists' Meeting "High Temperature Aspects of Hypersonic Flow", Rhode-Saint Genèse, Belgium, Apr. 3–6, 1962

Measurements made in the arc-wind tunnel of O.N.E.R.A. have presented a number of difficulties in their interpretation in the past. The direct measurement of temperature disturbed the flow near the arc and the homogeneity of flow through the tunnel, calculations for the behavior of a real gas were hard to calculate, errors could not be evaluated, and the quality of realization in the sonic region was difficult to simulate. Methods are proposed here for the resolution of these problems, and mathematical calculations are given for the accuracy of these methods. D.E.R.

N63-15338 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux

DEVELOPPEMENT DE LA COUCHE LIMITE DANS UNE TUYERE HYPERSONIQUE [DEVELOPMENT OF THE BOUNDARY LAYER IN A HYPERSONIC BLAST NOZZLE]

R. Michel [1962] 36 p 4 refs In French Presented at AGARD Specialists' Meeting "High Temperature Aspects of Hypersonic Flow", Rhode-Saint-Genèse, Belgium, Apr. 1962

The work to establish a theoretical method for the development of a boundary layer along the walls and inner surfaces of hypersonic nozzles and the study of the general entropy of a hypersonic wave are summarized. D.E.R.

N63-15343 Technical Research Group, Syosset, N.Y.

CAVITY SHAPE AND DRAG IN VENTILATED FLOW; THEORY AND EXPERIMENT

Peter Thomsen Feb. 1963 2 refs
(TRG-156-SR-2)

A three-dimensional cavity theory is developed and applied to ventilated flow around surface-piercing struts. Previous studies had indicated that two-dimensional theory was adequate for predicting cavity drag, but that three-dimensional analysis was required for predicting cavity length. Theoretical cavity-length results are compared to length measurements made in cavity-side photos, with special emphasis on observing the change in flow states with increasing speed. At high speed, the strut cavity was found to be sealed off from the atmosphere by the surface flow, causing a change in flow state. The results obtained for cavity length can be used in further developing the theory of cavity shape for application to the design of strut–hydrofoil systems. M.P.G.

N63-15344 United Aircraft Corp. Research Labs., East Hartford, Conn.

AN EXPERIMENTAL METHOD FOR MEASURING THE FLOW PROPERTIES OF AIR UNDER EQUILIBRIUM AND NON-EQUILIBRIUM FLOW CONDITIONS

Olof L. Anderson [1962] 23 p 8 refs Presented at the AGARD Specialists' Meeting on High Temperature Aspects of Hypersonic Flow, Rhode-St.-Genèse, Belgium, Apr. 3–6, 1962

A spectroscopic method suitable for use in shock tubes and other high-temperature test facilities has been developed to measure the temperature and mole concentration of oxygen in air between 300° K and 3000° K with microsecond time resolution. This measuring technique is based on the light-absorption properties of the oxygen molecule in the Schumann–Runge continuum which may be related to the vibrational temperature and mole concentration of oxygen in air. Since vibrational temperature and mole concentration may be defined without the assumption of thermodynamic equilibrium, this method is particularly suitable for measurements of the properties of air which are not in chemical equilibrium. Temperature and density measurements of shock-heated oxygen-argon mixtures, and also of air, were made to evaluate the accuracy of the equipment. It was determined that measurements of temperature between 1000° K and 3000° K can be made with 10% to 15% accuracy, and that measurements of mole concentration can be made with about 4% accuracy. Author

N63-15359 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux

RESCHERCHES SUR LA THEORIE HYPERSONIQUE DES PETITES PERTURBATIONS [RESEARCH ON THE HYPERSONIC THEORY OF SMALL PERTURBATIONS]

Jean-Pierre Guiraud May 1962 134 p 50 refs In French
(ONERA-107)

The general hypersonic theory of small perturbations of a flow is presented and a simple example is mathematically solved. The shock expansion method of calculating small perturbations and its applications are reviewed; the hypersonic theory of small perturbations is applied to the effect of the flow over a blunt-nosed body. Trans. by D.E.R.

N63-15388 Thompson Ramo Wooldridge, Inc., TAPCO Div. Cleveland, Ohio

MERCURY WETTING AND NON-WETTING CONDENSING RESEARCH Progress Report No. 3, July-Dec. 1962

R. G. Gido and Alfred Koestel Jan. 1963 116 p 57 refs
(NASA Contract NAS3-2159)
(ER-5214) OTS: $9.60 ph, $3.68 mf

The investigation consists of both an analytical and an experimental phase. The experimentation consists of local pressure-drop measurements for condensing mercury in horizontal straight and tapered steel tubes. Both wetting and nonwetting conditions are explored. The analysis consists of the formulation of a dropwise condensing fluid-mechanic model for correlating the data obtained from the nonwetting forced-convection condensation tests. Also included is a hydrodynamic stability analysis of liquid films for application to wetting condensing and its multitude of possible flow patterns. This analysis is required to match the proper flow regime with its pressure-drop correlation. The test data are compared with the Lockhart-Martinelli correlation to indicate agreement and note shortcomings. The state-of-the-art of two-phase fluid mechanics is reviewed. Nonwetting pressure-drop data are tabulated, with only preliminary attempts of correlation indicated. Author

N63-15392 Sandia Corp., Albuquerque, N. Mex.

PRECISION TEMPERATURE CONTROL OF AIR AND OIL BATHS

N. L. Hensinger Mar. 1963 20 p
(SCTM-71-63(24)) OTS: $0.50

Precise temperature control of a variety of laboratory air and oil baths has been achieved by means of a simple variable-reactance temperature controller. This controller, in combination with a carefully designed air bath, has achieved temperature control to ±0.003° C. In combination with a carefully designed oil-circulation system, temperature control to ±0.02° C has been achieved in large oil baths. The controller employs one or more heaters carrying a continuous current to compensate for heat losses to the atmosphere, and a second, intermittent current to provide temperature control. Both the continuous and control currents are variable over wide ranges to make the control unit readily adaptable to a wide range of cabinets, chambers, tanks, etc. Author

N63-15427 General Electric Co. Research Lab., Schenectady, N.Y.

LEADING EDGE BLUNTNESS AND SLIP FLOW EFFECTS IN HIGH TEMPERATURE HYPERVELOCITY FLOW OVER A FLAT PLATE

H. T. Nagamatsu, J. A. Weil, and R. E. Sheer, Jr. [1962] 38 p 43 refs Presented at AGARD Specialists' Meeting on High Temperature Aspects of Hypersonic Flow, Rhode-St.-Genese, Belgium, Apr. 3-6, 1962
(Supported by the Air Force)

An investigation was conducted in a hypersonic shock tunnel to study the effects of leading-edge bluntness on rarefied hypersonic flow over a flat plate. The free-stream Mach number range was 7.80 to 25.4 with corresponding stagnation temperatures of 2600° and 7000° R. For these test conditions, the strong interaction parameters, $\chi = M_1^3/\sqrt{Re_x}$, varied from 2.46 to 658. The leading-edge Knudsen number varied from 0.011 to 2.14 with a leading-edge thickness of 0.035 inch. Schlieren photographs at these test conditions indicated the existence of a detached shock wave for a Knudsen number range of 0.011 to 0.076. When the Knudsen number is approximately 0.011 or less, the leading edge can be considered blunt resulting in an increase in the heat-transfer rates over the case of a sharp flat plate. As the Knudsen number increases, the shock wave is not detached, and the strong shock wave and boundary layer are delayed in forming due to slip flow phenomenon at the leading edge. Author

N63-15455 Max-Planck-Institut für Strömungsforschung, Göttingen (W. Germany)

BERECHNUNG DER POTENTIALSTRÖMUNG UN MEHRERE PROFILE MIT GEGENSEITIGER BEEINFLUSSUNG [CALCULATION OF THE POTENTIAL FLOW AROUND SEVERAL PROFILES WITH TWO-WAY INFLUENCE]

K. Jacob (Aerodynamische Versuchsanstalt, Göttingen) 1962 51 p 44 refs In German
(Its Mitteilungen 27)

A method was developed for calculating the two-dimensional incompressible potential flow around several arbitrary, thick profiles which are in the same flow field and exert mutual interference. This is a singularity method dealing with vortices surrounding the profile countours. The mutual interference of the profiles can be effectively determined by iteration. The calculation consists mainly of setting up matrices, matrix-vector-multiplications, and the solution of linear equations. An IBM 650 computer program has been set up for cases involving two profiles. The method of calculation described was applied to the following profiles: a slat, a slotted flap, ground effects, and a biplane system. I.v.L.

N63-15475 Polytechnic Inst. of Brooklyn, N.Y.

THERMAL AND CHEMICAL EFFECTS IN WAKES

Martin H. Bloom [1962] 14 p 16 refs Presented at the AGARD Meeting on High Temperature Aspects of Hypersonic Flow, Brussels, Belgium, Apr. 3-6, 1962
(Contract AF 49(638)-445)

The far-wake, the regions in which diffusive phenomena become important and boundary-layer phenomena can be approximated, is discussed quantitatively. The thermal and chemical effects bearing on observable phenomena are discussed, along with the fluid mechanical factors that these effects depend upon. Topics include: scaling, similitude, and orders of magnitude; temperature distributions and electron densities in far-wakes calculated with coupled diffusion and detailed rate chmistry of multicomponent air; effects of differing values of the Lewis and Prandtl number; three-dimensional effects; streamwise pressure gradient effects; and unsteady effects. D.E.R.

N63-15483 Texas U., Austin

DIFFUSION OF GASES IN AQUEOUS SOLUTIONS Technical Report, Mar. 1, 1958 to Feb. 28, 1963

D. M. Himmelblau Mar. 1, 1963 163 p 55 refs
(Contract DA-23-072-ORD-1224)
(AROD-1948-2)

Three methods of measuring the diffusion coefficients of gas in liquids were employed; the one found most generally satisfactory was the laminar liquid jet. A number of theoretical and semitheoretical methods of predicting diffusion coefficients are discussed, and the methods compared with empirical data. The Wilke and Chang method is preferred since it is simple and fits the data as well as any other method. Unfortunately, the empirical data available as a result of this work, or any other investigation, is so lacking in agreement as to preclude a firm decision as to the correct method of predicting diffusion coefficients, or interpreting them from theories of liquids. Author

N63-15484 Aro, Inc. Arnold Air Force Station, Tenn.

AN ANALYSIS OF INITIAL STATIC PRESSURE PROBE MEASUREMENTS IN A LOW-DENSITY HYPERVELOCITY WIND TUNNEL

David E. Boylan Arnold Engineering Development Center, Apr. 1963 21 p 8 refs
(Contract AF 40(600)-1000)
(AECD-TDR-63-94)

An initial experimental program was conducted in 1961 to study the problems in using static-pressure probes for flow-calibration purposes in low-density, hypervelocity wind tunnels with continuous flow. This is a review of these data in the light of more recent data on thermal transpiration. Results indicate that such probes may be used for what might be termed secondary calibrations, but care is required in interpreting the results. The present experiment yielded data which are compared to static pressures calculated from impact-pressure probe calibrations. Author

N63-15509 Space Technology Labs., Inc., Redondo Beach, Calif.

AN INVESTIGATION OF RESONANT, NONLINEAR, NONPLANAR FREE SURFACE OSCILLATIONS OF A FLUID

R. E. Hutton Washington, NASA, May 1963 67 p 5 refs
(NASA Contract NASr-80)
(NASA TN D-1870) OTS: $1.75

A theoretical investigation was conducted of the motion of fluid in a tank, subjected to lateral harmonic vibration at a frequency in the neighborhood of the lowest resonant frequency of the mass of fluid. The investigation indicates that nonplanar fluid motion is due to a nonlinear coupling between fluid motions parallel and perpendicular to the plane of excitation, and that this coupling takes place through the free-surface waves. These theoretical conclusions

were experimentally confirmed using a cylindrical tank about 12 inches in diameter and partially filled with water to a depth of about 9 inches. Author

N63-15520 James Forrestal Research Center, Princeton U., N.J.
A HIGH INTENSITY MOLECULAR BEAM APPARATUS Technical Report
J. Deckers and J. B. Fenn June 1962 40 p 12 refs
(Contract Nonr-1858(25); Proj. Squid)
(PR-103-P)

A high-intensity molecular-beam apparatus is described which is based on a supersonic-stream gas source. Intensities of the order of 10^{17} molecules/cm^2/sec have been achieved with nitrogen. These represent a substantial fraction of theoretical predictions. The possibility of achieving higher than thermal energies is suggested. Possible applications of the apparatus are outlined. Author

N63-15521 Boeing Scientific Research Labs., Seattle, Wash.
ON SLENDER BODIES OF MINIMUM DRAG IN NEWTONIAN FLOW
David G. Hull Jan. 1963 44 p 9 refs
(Flight Sciences Lab. TR-67; D1-82-0224)

In recent papers by Miele, the problem of minimizing the pressure drag of slender bodies in Newtonian flow was considered in general, and solved for those particular cases in which, of the four geometric properties being considered (thickness, length, enclosed area, and moment of inertia of the contour for two-dimensional shapes; and diameter, length, wetted area, and volume for axisymmetric shapes), two are prescribed and the remaining two are free. In this paper, the analysis is extended to the class of problems in which three quantities are prescribed and the remaining is free. After the variational problem is reformulated in order to account for the fact that the pressure coefficient must be nonnegative everywhere, special attention is devoted to those particular cases in which two of the three prescribed quantities are the thickness and the length. In each case, a one-parameter family of extremal solutions is obtained, the parameter being related to the three prescribed quantities. Further, each family of extremal solutions contains three classes of body shapes: (1) an infinitely thin plate or a spike followed by a regular shape, (2) a regular shape only, and (3) a regular shape followed by a constant thickness contour or a cylinder. In all of the cases considered, analytical expressions are obtained for the geometry of the optimum shapes and the associated drag coefficients. Author

N63-15528 Advisory Group for Aeronautical Research and Development, Paris (France)
DISCUSSIONS FOLLOWING THE PRESENTATION OF PAPERS ON HYPERSONICS
July 1957 47 p Eleventh Meeting of the Wind Tunnel and Model Testing Panel, Scheveningen, Netherlands, 8–12 July, 1957
(AGARD-132-147)

Discussions on the following papers are presented: (1) Introductory Remarks Concerning Some Aspects of the Hypersonic Research and Research Facility Requirements; (2) Dynamics of a Dissociating Gas. III: Non-Equilibrium Theory; (3) Molecular Approach to Problems of High-Altitude, High-Speed Flight; (4) Design and Operation of Hypersonic Wind Tunnels; (5) The Hypersonic Facility of the Polytechnic Institute of Brooklyn and Its Application to Problems of Hypersonic Flight; (6) Research in the Naval Ordnance Laboratory Ballistic Ranges; (7) The Use of Gun-Launched Models for Experimental Research at Hypersonic Speeds; (8) The Light Gas Hypersonic Gun Tunnel at Armament Research and Development Establishment, Fort Halstead, Kent; (9) NACA Hypersonic Rocket and High-Temperature Jet Facilities; (10) Hypersonic Flow about a Thin Body of Revolution; (11) Some Remarks on Hypersonic Fluid Mechanics; (12) The Tube Wind Tunnel—A Special Type of Blow-Down Tunnel; (13) The Shock Tunnel and Its Application to Hypersonic Flight; (14) Physical Gas Dynamics at the AVCO Research Laboratory; and (15) Some Considerations on the Problems of High-Temperature Shock Tubes. I.v.L.

N63-15536 California U., Los Angeles
INSTABILITY OF STRATIFIED SHEAR FLOW Final Report
Jorgen Holmboe Mar. 1963 107 p 9 refs
(Contract AF 19(604)-7999)
(AFCRL-63-238)

A systematic introduction to the theory of long unstable cyclone waves in atmospheric models is presented. This approach takes into account the compressibility of the air and the rotation of the earth. The similarity of the physical mechanism of instability in the different atmospheric models is emphasized by the use of the symmetric wave method in the mathematical analysis of the models. This method studies the instability of stratified shear flow as an initial value problem, instead of deriving the instability from the properties of the normal modes of the system. M.P.G.

N63-15561 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
RATE OF LIQUID JET BREAKUP BY A TRANSVERSE SHOCK WAVE
Gerald Morrell Washington, NASA, May 1963 28 p 13 refs
(NASA TN D-1728) OTS: $0.75

The breakup of a single water jet by a transverse shock was studied experimentally in a 2.7- by 2.7-inch shock tube equipped with a variable-length high-pressure section. High-speed backlighted photographs were analyzed to obtain breakup time and liquid deformation. Breakup time decreased regularly with an increase in gas velocity and increased with jet radius. The extent of deformation was a linear function of the ratio of Weber number to the square root of Reynolds number based on initial jet radius. A theoretical model was developed based on stripping from a liquid-phase boundary layer, and an explicit function for breakup time resulted. The calculated breakup times were found to be in fair agreement with the measured values. Author

N63-15602 Douglas Aircraft Co., Inc. Missile and Space Systems Div., Santa Monica, Calif.
EXPERIMENTAL WORK ON TRANSITION AT HYPERSONIC SPEEDS
R. E. Deem *In its* Results of Independent Research and Development Studies by the Douglas Aerophysics Laboratory Staff in Fluid Mechanics and Simulation Techniques, Fiscal Year 1962 Jan. 1963 16 p 6 refs (See N63-15601 12-10)
(SM-41379-1)

Boundary-layer transition has been successfully detected on conical bodies in hypersonic airstreams. Shadowgraphs and, alternatively, china-clay techniques were applied in the DAL hypersonic two-foot wind tunnel. The best shadowgraphs are obtained by mounting the film plate at the edge of the free jet adjacent to the model. Eugenol is a suitable wetting agent for detecting transition on china-clay coatings in these experiments. Transition measurements by the alternative methods agree, and indicate rather early transition, possibly due to surface roughness or an unrealistically high base pressure. Recent measurements of transition by similar techniques are also reported for a flat plate in supersonic airflow in the DAL trisonic four-foot wind tunnel. Author

N63-15617 General Applied Science Labs., Inc., Westbury, N.Y.
RESULTS OF LAMINAR AND TURBULENT WAKE CALCULATIONS FOR A NOL TEST SPHERE
A. Fields Apr. 12, 1963 19 p 5 refs
(Contract NORd-18053)
(GASL-TM-76-A)

This memorandum presents the results of laminar and turbulent wake calculations for the same size sphere. The flight velocity and free-stream temperature remained fixed; the free-stream pressure level was 100 mm Hg. The flight velocity and sphere size were chosen in accordance with the current firing capability of the NOL 1000-foot range. The pressure levels were chosen so as to illustrate significant changes in the chemical effects of the far wake. Author

N63-15693 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

PERFORMANCE CAPABILITY OF SINGLE-CAVITY VORTEX GASEOUS NUCLEAR ROCKETS

Robert G. Ragsdale Washington, NASA, May 1963 70 p 20 refs (NASA TT D-1579) OTS: $1.75

An analysis was made to determine the maximum powerplant thrust-to-weight ratio possible with a single-cavity vortex gaseous reactor in which all the hydrogen propellant must diffuse through a fuel-rich region. An assumed radial temperature profile was used to represent conduction, convection, and radiation heat-transfer effects. The effect of hydrogen property changes due to dissociation and ionization was taken into account in a hydrodynamic computer program. It is shown that, even for extremely optimistic assumptions of reactor criticality and operating conditions, such a system is limited to reactor thrust-to-weight ratios of about 1.2×10^{-3} for laminar flow. For turbulent flow, the maximum thrust-to-weight ratio is less than 10^{-3}. These low thrusts result from the fact that the hydrogen flow rate is limited by the diffusion process. The performance of a gas-core system with a specific impulse of 3000 seconds and a powerplant thrust-to-weight ratio of 10^{-2} is shown to be equivalent to that of a 1000-second advanced solid-core system. It is therefore concluded that a single-cavity vortex gaseous reactor in which all the hydrogen must diffuse through the nuclear fuel is a low-thrust device and offers no improvement over a solid-core nuclear-rocket engine. To achieve higher thrust, additional hydrogen flow must be introduced in such a manner that it will bypass the nuclear fuel. Author

N63-15697 California U., Berkeley. Inst. of Engineering Research

FLAT PLATE SKIN FRICTION IN LOW DENSITY HYPERSONIC FLOW—PRELIMINARY RESULTS

E. S. Moulic Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Feb. 1963 30 p 8 refs
(Contract AF 33(657)-8607)
(ARL-63-24)

Experimental local skin-friction data were obtained for the strong interaction region of a sharp-edged adiabatic flat-plate model over the flow parameter ranges $5.5 < M < 6.0$; $150 < Re_x < 400$; $9.8 < \bar{\chi} < 13.0$. These data, the results of the first trials of a complex experimental apparatus, yield local skin-friction coefficients significantly below the predictions of strong interaction theory. Author

N63-15699 Calif. Inst. of Tech. Hydrodynamics Lab., Pasadena

SMALL-TIME BEHAVIOR OF UNSTEADY CAVITY FLOWS

D. P. Wang and T. Yao-tsu Wu Mar. 1963 49 p 18 refs
(Contract Nonr 220(35))
(Rept. 97-3)

A perturbation theory is applied to investigate the small-time behavior of unsteady cavity flows in which the time-dependent part of the flow may be taken as a small-time expansion superimposed on an established steady cavity flow of an ideal fluid. One purpose of this paper is to study the effect of the initial cavity size on the resulting flow due to a given disturbance. Various existing steady cavity-flow models have been employed for this purpose to evaluate the initial reaction of a cavitated body in an unsteady motion. Furthermore, a physical model is proposed to give a proper representation of the mechanism by which the cavity volume may be changed with time; the initial hydrodynamic force resulting from such change is calculated, based on this model. Author

N63-15709 Polytechnic Inst. of Brooklyn, N.Y.

AN INVESTIGATION OF A THREE-DIMENSIONAL TURBULENT BOUNDARY LAYER IN HYPERSONIC FLOW

Gennaro F. Aeillo Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Feb. 1963 50 p 24 refs
(Contract AF 33(616)-7661)
(ARL 63-26)

Turbulent heating rates have been measured by means of the shrouded-model technique on a blunted cone at angle-of-attack. The Reynolds number, based on conditions at the stagnation point, was varied from 1.7×10^6 to approximately 3.7×10^6. The enthalpy ratio (stagnation to wall) varied from 2.1 to approximately 1.5. The experimental data are compared to the flat-plate reference-enthalpy theory applied along the inviscid streamlines. It is shown that this relatively simple method is in reasonable agreement with the data. Author

N63-15759 Netherlands Ship Model Basin, Wageningen

ON THE GROWTH OF NUCLEI AND THE RELATED SCALING FACTORS IN CAVITATION INCEPTION Laboratory Memorandum No. 11

F. van der Walle [1962] 31 p 10 refs

Cavitation inception, the process by which microscopic nuclei grow to such a size that their presence can be detected by microscopic methods, is reviewed. The influence of nuclei on gas flow and the equations that govern the generation, growth, and the inception of nuclei are derived and examined. It is found that the various factors of inception are more or less equal in magnitude, with none playing a dominant role. However, all are necessary to the phenomenon. D.E.R.

N63-15761 California Inst. of Tech. Div. of Engineering and Applied Science, Pasadena

THE COLLAPSE OF A SPHERICAL CAVITY IN A COMPRESSIBLE LIQUID

Robert Hickling and Milton S. Plesset Mar. 1963 35 p 19 refs
(Contract Nonr-220(28))
(Rept. 85-24)

This paper presents numerical solutions for the flow in the vicinity of a collapsing spherical bubble in water. The bubble is assumed to contain a small amount of gas, and the solutions are taken beyond the point where the bubble reaches its minimum radius up to the stage where a pressure wave forms and propagates outward into the liquid. The motion up to the point where the minimum radius is attained, is found by solving the equations of motion both in the Lagrangian and in the characteristic forms. These are in good agreement with each other and also with the approximate theory of Gilmore, which is demonstrated to be accurate over a wide range of Mach number. The liquid flow after the minimum radius has been attained is determined from a solution of the Lagrangian equations. It is shown that an acoustic approximation is quite valid for fairly high pressures, and this fact is used to determine the peak intensity of the pressure wave at a distance from the center of collapse. It is estimated, in the case of typical cavitation bubbles, that such intensities are sufficient to cause cavitation damage. Author

N63-15762 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

BOUNDARY-LAYER DISPLACEMENT EFFECTS IN AIR AT MACH NUMBERS OF 6.8 AND 9.6

Mitchel H. Bertram Washington, NASA, 1959 27 refs
(NASA TR R-22; Supersedes NACA-TN-4133) GPO: $0.40

Measurements are presented for pressure gradients induced by a laminar boundary layer on a flat plate in air at a Mach number of 9.6, and for the drag of thin wings at a Mach number of about 6.8 and zero angle-of-attack. The pressure measurements at a Mach number of 9.6 were made in the presence of substantial heat transfer from the boundary layer to the plate surface. The measured pressure distribution on the surface of the plate was predicted with good accuracy by a modification to insulated-plate displacement theory which allows for the effect of the heat transfer and temperature gradient along the surface on the boundary-layer displacement thickness. The total drag of thin wings with square and delta planforms was measured at a nominal Mach number of 6.8 over a reasonably wide range of Reynolds numbers. The total drag was found to be greater than can be explained by adding a classical value of laminar skin friction to the estimated pressure drag. The difference is, in general, explained by the increase in skin friction (20 to 40 percent) caused by the boundary-layer-induced pressures. Author

12 GEOPHYSICS

Includes: auroral phenomena; upper atmospheric studies; cartography; geodesy; and geomagnetism.

For Van Allen belts see: 28 Space Radiation.

For related information see: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N63-15293 Alaska U. Geophysical Inst., College

THE DYNAMICAL MORPHOLOGY OF THE AURORA POLARIS

Syun-Ichi Akasofu Repr. from J. Geophys. Res., v. 38, no. 6, Mar. 15, 1963 p 1667–1673 11 refs
(NASA Grant NsG-201-62)

Simultaneous changes of auroral form, brightness, and motion over the whole polar region are studied, using IGY all-sky camera records from widely distributed stations in eastern Siberia, Alaska, Canada, northern United States (south of the Canadian border), and Greenland. During very quiet periods, and sometimes for brief intervals during magnetic storms, the aurora may consist of faint, diffuse, quiet arcs extending along the whole of the auroral zone that is in darkness. The onset of a polar magnetic substorm suddenly changes this quiet state of the aurora, especially on the morning part of the auroral zone. The aurora becomes active all along the zone, but in different ways at different local times, that is, at different positions relative to the midnight meridian. Active auroral displays last for a few hours, 1 to 3, for example. Great auroral displays consist of an intermittent succession of such active periods. Large-scale dynamical features of the auroras, such as the breakup, formation of large loops, and drift motions, are discussed. Author

N63-15394 Florida State U., Tallahassee

THE KINETIC-ENERGY BUDGET OF THE STRATOSPHERE OVER NORTH AMERICA DURING THE WARMING OF 1957 Scientific Report No. 1

M. A. Lateef Apr. 15, 1963 105 p 21 refs
(Contract AF 19(628)-394)
(AFCRL-63-429)

The large and rapid decrease in kinetic energy of the lower stratosphere (100 to 25 mb) during the warming of mid-January to mid-February, 1957, has been investigated in terms of energy transport and generation processes. These processes are represented by the corresponding terms in the mechanical energy equation. The evaluation of these terms was carried out using the 100-mb, 50-mb, and 25-mb values of geopotential, temperature, the geostrophic wind components, and adiabatic vertical motion at each point of a grid covering most of the North American continent and the adjacent North Atlantic. The investigation considered a limited volume which exchanged energy with the surrounding atmosphere through the vertical boundaries as well as through the upper and lower boundary pressure surfaces. Author

N63-15444 Geophysics Corp. of America, Bedford, Mass.

VERTICAL TRANSPORT OF A CONCENTRATION PULSE IN A CONSTANT GRADIENT ATMOSPHERE Scientific Report No. 3

H. K. Brown and J. Pressman Dec. 1962 112 p
(ARPA-SD-112; ARPA Order 286-62)
(GCA-TR-62-4-G)

Two closed forms for the more extended problem of minor component transport in a linear scale-height atmosphere with thermal diffusion are presented. This is a mathematical contribution to the elucidation of the problem of the hold-up of materials in the upper atmosphere, and sheds light on the basic phase of the upper-atmosphere-pollution problem. The model atmosphere has a constant mean particle mass and a certain scale-height gradient in which the total concentration and pressure of the component are defined. Specific solutions for a fairly arbitrary initial distribution are found. D.E.R.

N63-15656 Fairchild Camera and Instrument Corp. Defense Products Div., Syosset, N.Y.

AN ANALYSIS OF METRIC PHOTOGRAPHIC DISTORTION CAUSED BY A CONICAL SHOCK WAVE

Maxwell R. Eichenwald [1962] 19 p 2 refs Presented at the 7th Annual Technical Symp. of the Soc. of Photographic Instrument Eng., New York, Aug. 6–10, 1962

A mathematical analysis of metric photographic distortion caused by a conical shock wave is given. The shock wave is treated as a right circular cone of a homogenous density somewhat greater than normal air. Then the Bennett formalism which uses a refraction dyadic (tensor) is applied. A specific calculation for distortion using the functions derived is given. N.E.A.

N63-15692 National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

AN EVALUATION OF DETAIL WIND DATA AS MEASURED BY THE FPS-16 RADAR/SPHERICAL BALLOON TECHNIQUE

James R. Scoggins Washington, NASA, May 1963 34 p 4 refs
(NASA TN D-1572) OTS: $1.00

This report presents and evaluates a method for measuring detail winds at high altitudes with an accuracy several times better than any current operational all-weather system. The method presented consists of tracking an aluminized spherical balloon with the FPS-16 radar, and subsequent data reduction and analysis to obtain wind data. Two techniques for reducing tracking data to obtain wind data are presented. These consist of statistical and polynomial approaches for eliminating measurement errors in the tracking data. Computer programs for data reduction were developed and are presented in outline form. Author

N63-15724 Pennsylvania State U. Ionosphere Research Lab., University Park

THEORETICAL DETERMINATION OF THE IMPEDANCE CHARACTERISTICS OF A CAPACITIVE IONOSPHERE ROCKET PROBE

J. R. Herman Mar. 1, 1963 76 p 14 refs
(Contract AF 19(604)-8012)
(*Its* Scientific Rept. 180; AFCRL-63-285)

The impedance characteristics of a capacitive ionospheric rocket probe have been determined as a function of the electron density, collision frequency, and temperature. The physical model used in developing the theory incorporated both effects of the

ion sheath which forms about the rocket body and the anisotropic nature of the surrounding magnetoionic medium. Results are obtained and numerically evaluated to show that the sheath makes a very significant contribution to the impedance characteristics.
Author

13 HEAT TRANSFER

Includes: ablation; cooling; heating; and other thermal effects.

For aerothermodynamics see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings and Control Surfaces.

For combustion see: 26 Propellants and Combustion.

For related information see: 11 Fluid Mechanics.

N63-15295 Rensselaer Polytechnic Inst. Interdisciplinary Materials Research Center, Troy, N.Y.

HEAT TRANSFER IN POROUS MEDIA CONTAINING A VOLATILE LIQUID

A. H. Nissan (West Virginia Pulp and Paper Co., New York), J. L. Walker (U.S. Rubber Co.), and David Hansen Repr. from Chem. Eng. Progr. Symp. Ser., Houston, v. 59, no. 41, 1963 p 114-121 9 refs
(NASA Grant NsG-100-60; NSF G-10183)

Measurements were made of the effective thermal conductivity of woven fiber glass sheets wetted with water, benzene, and methanol. Data were obtained at liquid saturation values from 0 to 100% and at temperatures from 25° to 70° C. The measurements of thermal conductivity were made by recording attenuation and phase shift in a sinusoidal temperature wave with distance of penetration. Heat-transfer rates much higher than would be predicted on the basis of simple conduction were observed. This phenomenon was observed to be temperature sensitive and also sensitive to the liquid saturation (percent pore volume filled with liquid), a maximum occurring in the range 40% to 60% saturation. The observed high heat-transfer rates are attributed to the mechanism of net evaporation in hot regions, diffusion of the vapor followed by net condensation in cooler regions.
Author

N63-15303 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN EXPERIMENTAL INVESTIGATION OF SEVERAL ABLATION MATERIALS IN AN ELECTRIC-ARC-HEATED AIR JET

Andrew J. Chapman Washington, NASA, Apr. 1963 39 p 13 refs
(NASA TN D-1520) OTS: $1.00

An investigation to determine the ability of several ablation materials to reduce surface heat transfer in an electric-arc-heated airstream has shown that ammonium chloride has a higher heat of ablation, and thus greater ability to reduce surface heat transfer, at stagnation enthalpy potential below 8,500 Btu/lb than Teflon, nylon, Avcoat 19, or GE-124. The trend of results indicates that, for stagnation enthalpy potential above 8,500 Btu/lb, nylon would have a higher heat of ablation than ammonium chloride because of an increased transpiration effect. Results obtained for a wide range of test stream conditions with subsonic and supersonic flow from the present investigation and several references indicate that the heat of ablation is primarily sensitive to stagnation enthalpy potential.
Author

N63-15341 College of Aeronautics, Cranfield (Gt. Brit.)

THE EFFECT OF CATALYTIC SURFACES ON STAGNATION POINT HEAT TRANSFER IN PARTIALLY DISSOCIATED FLOWS

J. R. Busing [1962] 14 p 9 refs Presented at the AGARD Specialists' Meeting on High Temperature Aspects of Hypersonic Flow, Rhode-St.-Genèse, Belgium, Apr. 3-6, 1962

Experimental results are presented which show that the heat-transfer rate to a silicon-monoxide-coated surface is less than that to a platinum surface when the flow outside the boundary layer is partially dissociated. It has been inferred from these results that the recombination coefficient for the platinum surface, used in these tests, lies between 6×10^{-4} and 6×10^{-3}. It has also been concluded, from one particular set of tests, that the flow in the stagnation region was not in equilibrium and was only half dissociated. Suggestions are made for the construction of a probe to measure atom concentrations and relaxation times in short duration flows.
Author

N63-15462 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE USE OF ABLATORS FOR ACHIEVING PROTECTION AGAINST HIGH THERMAL FLUX

Kenneth L. Wadlin and Joseph N. Kotanchik [1961] 25 p 6 refs Presented at the 1961 SAE Aerospace Eng. and Mfg. Meeting, Los Angeles, Oct. 9-13, 1961
OTS: $2.60 ph, $0.95 mf

The results of an experimental program directed toward the evaluation of ablation materials as a means of achieving protection against high thermal flux is presented. The facilities used to provide convective, radiative, and combined convective-radiative heating conditions are described briefly. The behavior and relative effectiveness of three classes of ablation materials for convective heating are described and evaluated. The effect of type of heating on noncharring and charring materials is evaluated. The influence of char thickness on phenolic-nylon is also investigated. The evaluation results indicate that charring ablation materials are superior to noncharring materials. This superiority is manifested in the longer protection time against heat penetration and in the insensitivity to type of thermal flux, radiative or convective. The maximum benefits of the char are obtained with only moderately thick char layers.
Author

N63-15471 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

A STUDY OF THE EFFECT OF MULTI-G ACCELERATIONS ON NUCLEATE-BOILING EBULLITION

Robert W. Graham and Robert C. Hendricks Washington, NASA, May 1963 31 p 10 refs
(NASA TN D-1196) OTS: $0.75

The effects of multi-g accelerations directed toward a heater surface for near-saturated and subcooled nucleate pool boiling were studied in a centrifuge. High-speed motion pictures and heat-transfer data were obtained in the test program. Subcooling effects were observed to be more significant than the acceleration effects. Acceleration did not appreciably influence the overall heat transfer when the nucleate boiling was characterized by vapor columns or bubble conglomerates. Acceleration did, however, influence the heat transfer in the vicinity of a site for discrete bubbles near the thermal threshold of nucleate boiling. For this case, maximum bubble size, growth rate, frequency, and site activation were influenced by the acceleration magnitude.
Author

X63-15502 Atomic Energy Commission. Chicago Operations Office, Ill.

PROCEEDINGS OF THE NUCLEAR SUPERHEAT MEETING—NO. 7, SEPTEMBER 12, 13, AND 14, 1962, SIOUX FALLS, SOUTH DAKOTA

AEC Div. of Tech. Inform., Oct. 30, 1962 203 p 162 refs
(TID-7658) OTS: $3.00

The papers presented covered the following areas: out-of-pile, superheat, cladding corrosion-erosion and coolant chemistry tests; superheater fuel fabrication, irradiation, and activation results; BORAX-V operating results; superheat reactor physics; superheat in-core instrumentation development; steam-water separation and heat transfer; and reactor design and construction.
R.C.M.

N63-15507 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRESSURE AND HEAT-TRANSFER MEASUREMENTS ON THE FLAT FACE OF A BLUNTED 10° HALF-CONE BODY (SEMIDISK) AT A MACH NUMBER OF 6.15

P. Calvin Stainback. Washington, NASA, May 1963. 22 p. 10 refs. (NASA TN D-1628) OTS: $0.75

An experimental investigation was conducted to evaluate the flow characteristics of the front face of a 10° half-cone blunted approximately 85 percent with respect to the base radius. The front face was flat and inclined at an angle of 60° with respect to the original axis of the cone. The instrumented portion of the model was essentially a semidisk. Tests were conducted at a nominal Mach number of 6.15 and a nominal stagnation temperature of 450° F for an angle-of-attack range of 0° to 60°. The test-section Reynolds number was varied from 0.67×10^6 to 5.25×10^6 per foot for the heat-transfer tests and was 6.92×10^6 per foot for the pressure tests. The results indicated that the pressure and heat-transfer characteristics of the front face, at all angles-of-attack, were qualitatively similar to those of a disk normal to the free-stream velocity. The stagnation-point location was found to vary approximately linearly with angle-of-attack in the range investigated. The average heat-transfer coefficient over the face was essentially constant for the angle-of-attack range of this investigation, and approximately equal to the average coefficient of a disk situated normal to the free-stream velocity. Author

N63-15603 Douglas Aircraft Co., Inc. Missile and Space Systems Div., Santa Monica, Calif.

HYPERSONIC TURBULENT HEAT TRANSFER

R. E. Deem. *In its* Results of Independent Research and Development Studies by the Douglas Aerophysics Laboratory Staff in Fluid Mechanics and Simulation Techniques, Fiscal Year 1962. Jan. 1, 1963. 21 p. 6 refs. (See N63-15601 12-10)
(SM-41379-2)

Pressure and heat-transfer distributions have been measured on a standard model of a hypervelocity ballistic vehicle. The data pertain primarily to a turbulent boundary layer at Mach 8 at zero pitch and at a pitch angle of 20 degrees. Analysis of the data indicates that recovery temperature could not be measured accurately on the model; consequently, heat-transfer coefficients could not be determined reliably. However, an accurate description of the heat input to the model is afforded in terms of heat-transfer rates. Measured heat-transfer rates at the stagnation point remain rather inaccurate because of large conduction effects at the model nose. Development of a heat shield has been initiated to alleviate the conduction problem. Author

N63-15649 European Atomic Energy Community, Brussels (Belgium)

ETUDE A PROPOS DE L'ANOMALIE DE LA DISTRIBUTION DES TEMPERATURES DANS LES COUCHES SUPERFICIELLES D'UNE PAROI CHAUFFEE OU REFROIDIE, CONSTATEE PAR MONSIEUR JACQ. [STUDY CONCERNING THE ANOMALY OF TEMPERATURE DISTRIBUTION IN THE SURFACE LAYERS OF A HEATED OR COOLED WALL, FOUND BY MR. JACQ]

C. Bonnett and R. Morin. Joint Nuclear Research Center, Ispra Establishment, (Italy), 1963. 84 p. 6 refs. In French; English abstract (EUR 237.f). Available from the Belgium American Bank and Trust Co., New York, account no. 12186; 125 Belg. Fr.

In this report, the JACQ effect is described along with its possible influence on the calculation of heat-transfer coefficients. Experiments are made to reproduce this effect and to explain the reason for scattering in theoretical and practical values. It is shown how to measure exactly surface temperatures and obtain a method for rapid measurements of the diffusion. Author

N63-15651 Bombrini Parodi-Delfino S. p. A., Rome (Italy)

CRITERES POUR LE CALCUL DE REVETEMENT THERMIQUE DE TUYERES SOUMISES AU FLUX DE GAZ A HAUTE TEMPERATURE (PROPERGOL A IMPULSION SPECIFIQUE ELEVEE) PENDANT DES DUREES RELATIVEMENT LONGUES [CRITERIA FOR THE CALCULATION OF THE THERMAL CASING OF THE ROCKET NOZZLE UNDERGOING A FLOW OF GAS AT HIGH TEMPERATURE (PROPELLANT HAVING AN ELEVATED SPECIFIC IMPULSE) DURING SOME RELATIVELY LONG TESTS]

Francesco Bosman. [1963]. 41 p. 3 refs. In French
(*Its* Publ. 3/1963)

Practical criteria for the thermal protection of rocket nozzles are reviewed in the light of determining appropriate materials for the jacket and the casing. I.v.L.

N63-15662 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio

HEAT EXCHANGE DURING FREE MOVEMENT AROUND A HORIZONTAL CYLINDER IN RAREFIED AIR

A. K. Rebrov. Feb. 26, 1962. 13 p. 9 refs. Transl. from Inzhenerno-Fiz. Zhur. (Minsk), no. 9, 1961. p. 32–39
(FTD-TT-62-135/1+2)

Results are given that were obtained from experimental investigations of heat exchange during free movement of air around a horizontal cylinder in a rarefied space. Relations are given for the calculation of the heat exchange in a broad range of Gr Pr values and in the presence of a substantial temperature jump. Formulas are given that are valid for a body of any given form with a constant temperature over the surface, and consideration is made for the temperature jump by adding it as a second member in the denominator of the equation, $Nu_p = \frac{1}{Nu_k}$, in the form βK. D.E.R.

N63-15704 Imperial Coll. of Science and Tech., London (Gt. Brit.)

CONTRIBUTION TO THE THEORY OF THE STRUCTURE OF GASEOUS DETONATION WAVES

D. B. Spalding. Feb. 1962. 22 p. 13 refs.

The paper presents exact solutions to the equations governing the distributions of temperature, velocity, and pressure in a gaseous detonation wave, for the cases in which the dimensionless volumetric-reaction-rate w (a) has a concentrated peak near the hot boundary but negligible values elsewhere; (b) obeys the law

$$w = n(\tau - \tau_C)\left\{\left(\frac{\tau - \tau_C}{\tau_H - \tau_C}\right)^{n-1} - \left(\frac{\tau - \tau_C}{\tau_H - \tau_C}\right)^{2n-2}\right\}$$

where n is a constant, τ is the dimensionless stagnation temperature, and subscript C denotes upstream conditions. Other exact solutions are also discussed. The methods used are analytical and graphical, requiring no high-speed computing facility. The gas is supposed to have a Lewis Number of unity and a Prandtl Number of ¾: for convenience, its thermodynamic properties are supposed to be those of a perfect gas. Studies of the kind presented permit clear perception of most of the important properties of real gaseous detonations. Author

14 HUMAN BEHAVIOR

Includes: crew training and evaluation; piloting; psychological factors.

For simulators see: **10 Facilities.**

For related information see: **16 Life Sciences.**

N63-15382 Dunlap and Associates, Inc., Santa Monica, Calif.
AN EXAMINATION OF PILOT INFORMATION REQUIREMENTS
R. A. Westland, L. B. Weingarten, R. B. Kelly, and J. W. Wulfeck
Nov. 30, 1962 31 p 21 refs
(Contract Nonr-1076(00))

A number of procedures have been described for the analysis of pilot information requirements. Organic classification structures are proposed for a systematic examination of information and decision-action categories. Secondly, a functional proximity-level concept is introduced to define categories of data having varying degrees of importance in specific tasks. Finally, a control model is introduced to take into account various control states, pilot performance, and various trade-offs involved in meeting control requirements: automatic control elements; data processing; and display techniques. While representing an attack upon an already well-recognized problem area, an attempt has been made to reduce the problem of information requirements determination to a systematic basis. Author

N63-15447 Aerospace Medical Div. Aerospace Medical Research Lab. (6570th), Wright-Patterson AFB, Ohio
SIMULTANEOUS ACTIVATION OF BIMANUAL CONTROLS [Final Report, Feb. 1962 to Aug. 1962]
M. J. Warrick and Lester Turner Jan. 1963 13 p
(AMRL-TDR-63-6) OTS: $0.50

The time interval between the release of a right-hand key and a left-hand key, when subjects were attempting to release them simultaneously, was measured to 0.1 millisecond. The mean interval of 20 subjects, 60 trials per subject without knowledge of results, was very close to zero (simultaneous). Approximately 94 percent of the intervals were within ±20 milliseconds of zero. The implications of the findings to the control of a personal space-propulsion unit are discussed. Author

N63-15467 United States Industries, Inc. Educational Science Div., New York, N.Y.
PRELIMINARY EVALUATION OF A PROTOTYPE AUTOMATED TECHNICAL TRAINING COURSE [Final Report]
Felix F. Kopstein, Richard R. Cave (6570th Aerospace Med. Res. Labs.), and Virginia Zachert Wright-Patterson AFB, Ohio, Behavioral Sciences Lab., July 1962 27 p 17 refs
(Contract AF 33(616)-6983)
(MRL-TDR-62-78) OTS: $0.75

This field study, conducted at Keesler Air Force Base, Mississippi, constituted a preliminary evaluation of intrinsic programing for automated training. Automated instructional materials used during the first 6 weeks of the Communications Electronics Principles course were presented to beginning electronics students via 35-mm film on the AutoTutor Mark I, a rearview projection machine. Using the Keesler Mathematics Test, three groups—experimental, control, and blind control—were selected and matched from the middle ability range of each of two entering classes. The experimental group received via the machines all instruction normally received through lecture and discussion. However, they followed the usual method for their practical problems. The students using machines learned adequately from this experimental program. The interpretations of these results and implications for Air Force training are discussed. Author

N63-15564 George Washington U. Human Resources Research Office, Washington, D.C.
THE PREDICTION OF TRAINING REQUIREMENTS FOR FUTURE WEAPON SYSTEMS: A PERSONNEL SUPPORT SYSTEM RESEARCH AND DEVELOPMENT PROCESS
J. C. Rupe Apr. 1963 110 p 16 refs
(Contract DA-44-188-ARO-2)
(HumRRO-TR-83)

The current state-of-the-art for predicting personnel and training requirements during weapon-system design and development was determined by means of a literature review. The main object of this study was to develop procedures for effectively and economically providing human factors data, and products based upon them, needed for concurrent building of a personnel support system (conceived to be the operator and maintenance personnel for a weapon system and the basic job data, equipment, and materials required for selecting and training these personnel). Author

N63-15571 California U., Los Angeles
MEASURING PERFORMANCE CHANGES IN HIGHLY TRANSIENT EXTREME HEAT STRESS: RATIONALE, PROBLEM, AND EXPERIMENTAL PROCEDURES Final Report [July 1961–July 1962]
Hilde Groth and John Lyman Wright-Patterson AFB, Ohio, Biomedical Lab., Jan. 1963 26 p 45 refs
(Contract AF 33(616)-6763)
(AMRL-TDR-63-1)

A review of the existing state-of-the-art for handling human performance under transient heat stress has been made. It was concluded that it would be necessary to develop a new methodology based on "microperformance" measurements to assess severe, localized, transient heat stresses as relevant to contemporary flight problems. Author

N63-15621 Ohio State U. Lab. of Aviation Psychology, Columbus
A DIFFERENTIAL INFLUENCE OF AUGMENTED FEEDBACK ON LEARNING AND ON PERFORMANCE [Final Report, Dec. 1959–Oct. 1961]
Robert G. Kinkade Wright-Patterson AFB, Ohio, Behavioral Sciences Lab., Feb. 1963 15 p 15 refs
(Contract AF 33(616)-6964)
(AMRL-TDR-63-12) OTS: $0.50

The hypothesis that the training value of augmented feedback in a tracking situation will depend upon the discernibility of input and fundamental feedback signals was tested. Subjects performed a one-dimensional compensatory tracking task using a knob for positional control over the cursor. For two of four groups of subjects the reference element was noisy, oscillating at random about a null position, while for the other two it was not. Augmented feedback, in the form of auditory clicks at the rate of 2 per second when on target, was given one of each pair of groups during training. On subsequent test the performance of the group trained with augmented feedback and performing with the noisy display deteriorated to the level of its control group trained without feedback. But, the performance of the group trained with augmented feedback and performing on the noise-free display continued unchanged and superior to that of its control group trained without feedback. The results are regarded as confirming the hypothesis and as helping to explain previous contradictory findings on the value of augmented feedback. Author

15 INSTRUMENTATION

Includes: design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; and sensors and transducers.

***For related information see:* 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.**

N63-15282 Block Associates, Inc., Cambridge, Mass.
DEVELOPMENT OF A ROCKET-BORNE INFRARED SPECTROMETER EMPLOYING THE PRINCIPLES OF MOCK INTERFEROMETRY Scientific Report No. 4

Niels O. Young, Lawrence Mertz, and John Armitage Jan. 16, 1963 34 p 12 refs
(Contract AF 19(604)-5738)
(AFCRL-63-234)

CONTENTS:

1. MOCK INTERFEROMETRY (Appendix A) Niels O. Young, Lawrence Mertz, and John Armitage p A1–A7 3 refs (See N63-15283 12-15)
2. HETERODYNE INTERFERENCE SPECTROSCOPY (Appendix B) Lawrence Mertz p B1–B5 9 refs (See N63-15284 12-15)

N63-15283 Block Associates, Inc., Cambridge, Mass.

MOCK INTERFEROMETRY (Appendix A)

Niels O. Young, Lawrence Mertz, and John Armitage *In its* Development of a Rocket-Borne Infrared Spectrometer Employing the Principles of Mock Interferometry Jan. 16, 1963 p A1–A7 3 refs Presented at the Conf. on Optical Instruments and Techniques, London, July 11–14, 1961 under auspices of Internatl. Commission on Optics Submitted for Publication (See N63-15282 12-15)

A simulated interferometer for Fourier transform spectrometry is described with applications to diverse spectral regions (including ultraviolet) and to emission or absorption line profile studies. In addition to the usual advantages of interference spectrometry, the "mock interferometer" has the three following advantages: (1) The dimensional tolerances are low, making it applicable to the ultraviolet as well as making it extremely durable under adverse conditions. (2) It has no beam splitter problem and is applicable to any spectral region for which dispersers are available. (3) The fringe frequency is not necessarily proportional to the radiation frequency. Therefore, by shifting the zero fringe frequency to the neighborhood of a small spectral region, only a low order (few harmonics) Fourier transformation need be used. Use of the "mock interferometer" does not eliminate the need for Fourier transform computation to obtain the spectrum. This Fourier transformation may be performed by either digital or analog techniques. I.v.L.

N63-15284 Block Associates, Inc., Cambridge, Mass.

HETERODYNE INTERFERENCE SPECTROSCOPY (Appendix B)

Lawrence Mertz *In its* Development of a Rocket-Borne Infrared Spectrometer Employing the Principles of Mock Interferometry Jan. 16, 1963 p B1–B5 9 refs Presented at the 5th Cong. of Internatl. Comm. on Optics, Stockholm, Aug. 24, 1959 to Aug. 30, 1959 (See N63-15282 12-15)

An interferometric method which should be suitable for high resolution measurement of absorption lines is described. In this method one scans the Michelson interferometer fringes and multiplies them with other Michelson interferometer fringes from a known standard monochromatic source and then looks only at the lower resulting sideband in the vicinity of zero frequency. The appearance of the lower sideband depends on the phase of the monochromatic fringes. The unknown fringes are symmetrical and, when multiplied by cosine monochromatic fringes, yield a symmetrical results. This result is the cosine Fourier transform of the beat frequencies. Similarly, multiplication by sine monochromatic fringes yields the sine Fourier transform of the beat frequencies. Together, these uniquely specify the unknown spectrum in the neighborhood of the known monochromatic reference line. The advantages of this method are: (1) The precision inherits directly from that of the monochromatic reference, without mechanical intermediate standards such as gratings, lead screws, or spacings. Relatively crude optics are permissible. (2) The results are not entangled with overlapping orders so that adsorption line spectrometry may be carried out with little or no prefiltering. (3) A large acceptance angle is available for limited brightness sources. Furthermore, a corrector may be included to further increase the acceptance angle for very high resolution. (4) The wavelengths of the unknown spectrum are measured simultaneously, thus yielding Fellgett's signal-to-noise improvement. I.v.L.

N63-15287 Minnesota U. School of Physics, Minneapolis

SIMPLE CIRCUIT FOR A PHOSWICH SCINTILLATION COUNTER

L. E. Peterson and J. H. Nitardy 1961 3 p 1 ref Repr. from Review of Sci. Instruments, v. 32, no. 12, Dec. 1961 p 1390–1392
(NASA Contract NASw-56)

A simple, transistorized circuit is described which analyzes the frequency composition of the photomultiplier current pulse from a phoswich scintillation counter. The circuit generates a gate waveform from the fast current pulse of an organic scintillator, but not from the slower pulse from an inorganic crystal. Such a circuit finds application when the phoswich is used to provide an anticoincidence particle shield around a γ-ray spectrometer. Author

N63-15291 Minnesota U. School of Physics, Minneapolis

OBSERVATIONS OF THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER 1959. 2. THE CAPE-TOWN ANOMALY AND THE SHAPE OF THE OUTER BELT

Robert A. Hoffman Repr. J. Geophys. Research, v. 66, no. 12, Dec. 1961 p 4003-4006 9 refs
(NASA Contract NASw-56)

This paper shows that any particles affected by the Capetown magnetic anomaly do not have trajectories that would pass through the position of the experimentally observed minimum in the outer belt. Therefore, the minimum cannot be taken as evidence either for the effect of the anomaly on the trapped radiation or for support of the neutron albedo source for the outer-zone electrons. Author

N63-15361 Block Associates Inc., Cambridge, Mass.

DESIGN HISTORY AND THEORY OF OPERATION OF A TWO-CHANNEL, ROCKET-BORNE EBERT GRATING SPECTROMETER Scientific Report No. 5

Merle J. Persky, Eugene K. Dana, and Geert Wyntjee Jan. 9, 1963 44 p
(Contract AF 19(604)-5738; ARPA Order 30-60)
(AFCRL-63-254)

This report describes a two-channel Ebert grating spectrometer developed by Block Associates, Inc., The ultraviolet channel scans the 2300 Å to 7000 Å spectral region. The infrared channel scans the 2.3μ to 7μ spectral region. Built-in calibration is provided to monitor the response of the two spectral channels and the operation of the telemetering system. Data commutation is used to time-multiplex the information onto a single-channel data link. The system is fully transistorized, and both mechanical and electrical design are compatible with rocket-borne environments. Information is also presented on the details of operation of the instrument. Author

N63-15374 Du Pont de Nemours (E.I.) and Co. Savannah River Lab., Aiken, S.C.

EVALUATION OF A PERMEABILITY CELL

Albert E. Symonds, Jr. Jan. 1963 16 p 7 refs
(Contract AT(07-2)-1)
(DP-792) OTS: $0.50

A permeability cell incorporating an ionization chamber was designed. This instrument was used to measure the permeation of plastic films by tritiated water vapor. Author

N63-15433 Air Force Cambridge Research Labs. Electronics Research Directorate, Bedford, Mass.

IMPROVED HIGH MASS RANGE RESOLUTION WITH AN OMEGATRON MASS SPECTROMETER

J. H. Bloom, C. E. Ludington, and R. L. Phipps Oct. 1962 21 p 30 refs
(AFCRL-62-953)

The influence of changing the magnetic field on the resolution and sensitivity of the omegatron mass spectrometer is shown for

krypton. Good resolution may be extended through the mass range of the xenon isotopes (mass number 136) by carefully selecting the operating parameters of the omegatron. The resolution is plotted against the magnetic-field strength for Kr^{84+}, and follows the theoretical predictions within experimental error. The effect of varying the other parameters of the omegatron with krypton is shown and discussed. A summation of the work with xenon is also given. Author

N63-15474 Comitato Nazionale per l'Energia Nucleare. Lab. Nazionali, Frascati (Italy)

DISPOSITIVO PER IL RILEVAMENTO DI COORDINATE DI CAMERA A SCINTILLA, IN FORMA NUMERICA, CON REGISTRAZIONE SU SCHEDE [DEVICE FOR SCINTILLATION CHAMBER CO-ORDINATE TRACKING IN NUMERICAL FORM WITH REGISTRATION CARD]

M. Coli and A. Vignati Jan. 21, 1963 16 p In Italian
(*Its* Nota Interna 181; LNF-63/2)

A device, called a "coordinategraph," to record the graphic coordinates of scintillation chamber traces, is described. The traces are recorded by special equipment which is wired to a modified IBM 625 card puncher. The cards are analyzed by an IBM 1620 computer that yields X and Y coordinates of the traces.
Trans. by P.F.E.

N63-15489 Research Triangle Inst. Isotope Development Lab., Durham, N.C.

THE APPLICATION OF PHOTOSENSITIVE GAS COUNTERS TO SCINTILLATION COUNTING Final Report

R. L. Ely, Jr. and Lewis F. Ballard Mar. 31, 1962 28 p 13 refs
(Contract AT-(40-1)-2513)
(ORO-490) OTS: $0.50

A photocell has been constructed which incorporates variations of the standard cesium-antimony photosensitive film with a geiger tube and a scintillation liquid. This work was undertaken to determine whether the Cs-Sb photosurface could be modified to provide better wavelength and to test the idea of a geiger-scintillation detector. The expected low spectral response above 400μ was not obtained for any Cs/Sb ratio. It is concluded that, although the present results are negative, further investigation of the idea of a geiger-scintillation detector should be carried out. R.C.M.

N63-15530 Federal Aviation Agency. Systems Research and Development Service, Atlantic City, N.J.

EVALUATION OF AN OMNIDIRECTIONAL INTERROGATING METRIC WAVE PILOT WARNING INSTRUMENT Final Report

Karl H. Burkard and Berhart V. Dinerman Feb. 1963 53 p 5 refs

A Pilot Warning Instrument (PWI), developed by Motorola, Inc., Riverside, California, was tested to evaluate the technical feasibility of an omnidirectional, interrogating, metric wave technique for PWI applications, and to determine the operational utility of this PWI concept as a pilot aid for collision prevention. The PWI was subjected to laboratory, field, and airborne tests to determine the altitude-discrimination capability, range and bearing accuracies, and reliable communication range of the equipment. The results of the evaluation demonstrated inherent technique weaknesses in the form of self-generated, ground-reflected interference signals that seriously compromised the system performance. It was concluded that the PWI techniques implemented in the evaluation model were unsuitable for airborne use as a collision-prevention device. Author

N63-15551 Atomic Energy Commission. New Brunswick Lab., N.J.

THE MEASUREMENT OF M/E POSITIONS FOR A MASS SPECTROMETER USING A ROTATING COIL GAUSSMETER

Hugh O. Finley and Ralph J. Hemmer Apr. 1963 18 p 2 refs
(NBL-194) OTS: $0.50

A magnetic flux measuring system has been converted to use for the identification of mass over the number of charges (M/e) positions in a 6-inch radius, directional focusing, mass spectrometer. The voltage generated by a synchronous motor-driven "rotating coil" placed in the magnetic field of the analyzer section of the mass spectrometer is measured by a potentiometer. This measured voltage is a function of the field strength and may be used to calculate the M/e for a given ion energy and variable magnet-current setting. Two methods are used to determine the M/e values. The first method is for fast scanning over a wide M/e range of several hundred mass positions. The second method is for very accurate fractional M/e differences over a small mass range. The system is accurate to within 0.25 mass unit in the high-mass range and within a 0.1 mass unit at lower mass positions. Author

N63-15557 Du Pont de Nemours (E.I.) and Co. Savannah River Lab., Aiken, S.C.

FISSION GAS SAMPLER

P. H. Chismar Feb. 1963 10 p 2 refs
(Contract AT(07-2)-1)
(DP-814) OTS: $0.50

An apparatus was developed to release, measure, and sample free gases contained in irradiated fuel elements of uranium oxide. The apparatus is divided into two separate pieces of equipment, the gas-release unit and the vacuum and collection unit. The two units are joined to make an integral system. The gas-release unit punctures the outer sheath of the fuel element; the vacuum and collection unit measures the volume of released gas and collects a fraction of it. Author

N63-15567 Armour Research Foundation, Chicago, Ill.

DEVELOPMENT OF A SMALL SOIL STRAIN GAGE Final Report [May-Nov. 1962]

W. B. Truesdale et al Kirtland AFB, N. Mex., Research Directorate, Mar. 1963 71 p
(Contract AF 29(601)-5343)
(AFSWC-TDR-63-3)

A small strain gage was developed for the measurement of static and dynamic strains when embedded in soil samples. The gage itself consists of two sets of two coil discs; associated instrumentation includes electronic driving, amplifying, and recording circuitry. One set of coils is embedded in soil as the strain sensing element; the other is externally positioned to serve as a reference. The principle of operation is that of an air core differential transformer with a null balancing system to permit accurate measurements of small strains. Author

N63-15600 Bell Helicopter Co., Fort Worth, Tex.

ARMY-NAVY INSTRUMENTATION PROGRAM. STATUS REPORT THROUGH 30 JUNE 1962

Don Rosenquist, J. Perry, and W. C. Robinson 1962 35 p
(Contract Nonr-1670(00))
(ANIP 6-30-62)

The work accomplished by Bell Helicopter during the second quarter of 1962 under the Army-Navy Instrumentation Program is presented in this report. During this quarter, work continued on simulation experiments, the development of the RH-2 flight system, and report writing. This report summarizes financial information and the progress of the work accomplished. Author

N63-15618 Atomic Energy Commission. Idaho Operations Office, Idaho Falls

AUTOMATIC FILM DENSITY READING SYSTEM

Rex. B. Purcell and Hal Mc Gary Apr. 1, 1963 96 p
(IDO-12029) OTS: $2.00

This report describes an automatic film-density reading system in which (a) dosimetry film is identified with a film badge number

preassigned to a particular individual, (b) densities resulting from radiation exposure are observed and converted to voltage readings for each of four fields corresponding to exposures through four filtered media, and (c) these identification and density data, together with additional pertinent information, are automatically recorded on punched paper tape in a format compatible to data-processing equipment. Author

N63-15660 Naval Ordnance Lab., Corona, Calif.
JOINT SERVICES INFRARED SENSITIVE ELEMENT TESTING PROGRAM Summary [Report], 1962
W. L. Eisenman Mar. 1, 1963 18 p refs
(NOLC-TM-43-15)

Progress in the development of infrared sensitive detectors is reported. Included are: low-frequency noise projects, black detector development, quantitative data on radiation thermocouples and Golay detectors, evaluation of various detectors, and a new program to construct equipment to measure detector response in the submillimeter region of the spectrum. D.E.R.

N63-15663 Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.
A SIMPLIFIED SONIC ANEMOMETER FOR MEASURING THE VERTICAL COMPONENT OF WIND VELOCITY
J. Chandran Kaimal Jan. 1963 22 p 6 refs
(*Its* Instrumentation for Geophys. and Astrophys. -24; AFCRL-63-203)

The design and operation of a continuous-wave sonic anemometer for measuring fluctuations in the vertical wind velocity component are described. Use of highly directional transducers has greatly simplified the design. Field tests show that the instrument responds to the vertical fluctuations exactly as the more complicated but successful University of Washington sonic anemometer–thermometer. This system gives stable performance during prolonged continuous operation. The stability, accuracy, and simplicity make it a valuable tool for investigations of turbulence in the atmospheric boundary layer. Author

N63-15668 Naval Radiological Defense Lab., San Francisco, Calif.
CALORIMETRIC MEASUREMENTS OF GAMMA RAY, FAST NEUTRON, AND CHARGED PARTICLE ABSORBED DOSES
E. R. Schleiger, N. Goldstein, and E. Tochlin Jan. 28, 1963 26 p 13 refs
(USNRDL-TR-621)

The energy absorbed by aluminum, carbon, or tissue-equivalent (TE) material when exposed to gamma rays, fast neutrons, or 900-mev alpha particles was measured with a microcalorimeter. Gamma-ray-absorbed dose rates as low as 2 rads/min were measured with the instrument. The dose rates obtained from the exposures to Co^{60} and Cs^{137} sources at this Laboratory (NRDL) agreed with the output of the sources as measured with a National Bureau of Standards secondary standard-cavity ionization chamber. Thirteen 10-min exposures of the TE absorber in the microcalorimeter to fast neutrons from the University of California 60-in. cyclotron at Crocker Laboratory resulted in absorbed dose measurements varying from 24 to 40 rrads. The average absorbed dose value was 5 percent higher than the NRDL determination based on flux and spectrum measurements. Microcalorimeter exposures to the 900-mev alpha particle beam from the University of California 184-in. synchrocyclotron at Lawrence Radiation Laboratory gave absorbed doses that agreed reasonably well with ionization-chamber determinations. Author

16 LIFE SCIENCES

Includes: biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness.

For related information see: 14 Human Behavior; and 28 Space Radiation.

N63-15250 Melpar, Inc., Falls Church, Va.
RESEARCH ON DETECTION OF EXTRATERRESTRIAL LIFE BY ULTRAVIOLET SPECTROPHOTOMETRY First Quarterly Progress Report, 1 Jan. through 31 Mar. 1963
Sol S. Nelson [1963] 23 p 3 refs
(NASA Contract NASw-571)
OTS: $2.60 ph, $0.89 mf

Absorption maxima between 185 and 190 mμ were found in bovine serum albumin and ribonuclease. The absorbencies at all maxima for these proteins vary with pH, go through a maximum at pH 7, and then fall off sharply. Absorption maxima between 185 and 190 mμ were found for phenylalanine, tryptophan, and tyrosine, but not for glycine, alanine, or glycyl glycine. Present work includes a systematic study of dipeptides, tripeptides, and polypeptides, and a study of the contribution of aromatic amino acids to the observed absorption. Author

N63-15258 Library of Congress. Science and Technology Div., Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY. AN ANNOTATED BIBLIOGRAPHY, 1957 LITERATURE, VOLUME VI
Arnold J. Jacobius, Roman Kenk, Leroy D. Davis, Elizabeth G. Koines, Kristallo Pappajohn, Ilga M. Terauds, and Paul E. Spiegler 1963 364 p 1566 refs For Vol. IV see N63-90035; For Vol. V see N62-10854 03-16
(Supported by NASA, AF, and FAA)
OTS: $5.00

Included in this bibliography on *Aerospace Medicine and Biology* are: Physiology, Space Biology, Psychology, Pharmacology, Toxicology, Safety, Survival, and Rescue. J.A.J.

N63-15270 New York U. Coll. of Engineering, N.Y.
PRODUCTION OF OXYGEN FROM SPACE MINERALS
E. R. Kaiser, J. Tolciss, and Kurt Komarek Feb. 1, 1963 42 p 47 refs
(NASA Grant NsG-9-59)
(Tech. Rept. 690.1) OTS: $4.60 ph, $1.46 mf

CONTENTS:
1. KINETICS AND THERMODYNAMICS FOR THE REDUCTION OF SPACE MINERALS BY HYDROGEN (APPENDIX) K. Komarek p A1–A14 8 refs (See N63-15271 12-07)

N63-15275 California U., Berkeley. Inst. for Basic Research in Science
MICROENVIRONMENTS FOR LIFE ON MARS
Joshua Lederberg and Carl Sagan (Stanford U. School of Medicine, Calif.) Repr. from the Proc. of the Natl. Acad. of Sci., v. 48, no. 9, Sept. 1962 p 1473–1475 22 refs
(NASA Grants NsG-81-60 and NsG-126-61)

It has been fairly well determined that some terrestrial microorganisms can survive in purported simulations of the Martian environment. Surface temperatures vary from −200° K to 310° K. Seasonal changes in the polar ice cap imply a variation in the availability of atmospheric water vapor. Substantial moisture may be frozen in the subsoil. Also, moisture and warmth may be available through localized geothermal activity. A search for favorable microhabitats can be made from planetary flyby vehicles such as the Mariner series. J.A.J.

N63-15355 St. Louis U. School of Medicine, Mo.

CONTINUOUS SIMULTANEOUS REGISTRATION OF SWEATING AND BLOOD FLOW IN A SMALL SKIN AREA [Final Report, Nov. 1961-Nov. 1962]

Alrick B. Hertzman and Franz Flath Wright-Patterson AFB, Ohio Biomedical Lab., Feb. 1963 13 p 18 refs

(Contract AF 33(616)-7077)

(AMRL-TDR-63-16) OTS: $0.50

The report presents a capsular method for recording evaporation from a small skin area (5, 10, or more cm^2) continuously, quantitatively, and with a very fast response time as brief as 0.15 seconds. Water of diffusion at rates of 0.005 $mgm/cm^2/min$. or high sweating rates were measured with equal ease. The method is combined with photoelectric recording of the skin pulses to provide precise temporal relations of cutaneous vascular events and of sweating in forearm skin occurred synchronously with digital vasoconstrictions but were not accompanied by changes in the rate of blood flow in forearm skin although venoconstriction in the forearm often took place with an increase in sweating. The observation contradicted the concept of bradykinin as an important vasodilator in accounting for cutaneous vasodilatation during heat stress.

Author

N63-15356 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio

GASEOUS EXCHANGE IN A CLOSED ECOLOGICAL SYSTEM [Final Report, Apr. 1961-June 1962]

Sheldon A. London and Arselus West Dec. 1962 23 p 44 refs

(AMRL-TDR-62-139) OTS: $0.75

A series of experiments was performed to determine the feasibility of using several types of organisms to maintain a gaseous balance in a closed system. The system consisted of: (a) a photosynthetic unit comprised of cells of Chlorella pyrenoidosa strain TX 71105, (b) a biological aerobic sewage-digesting unit, (c) a unit containing an ammonia-utilizing fungus, Linderina pennispora, and (d) an animal chamber containing a white, adult male rat. Although many difficulties were encountered, this bioregenerating unit could be operated under closed conditions for 390 hours. Gas analyses indicated CO_2 and O_2 levels can be maintained at desirable levels. Material balance within the system was not attempted. However, nitrogen analysis of the resultant fungal mass showed that data on the basic physiology of the organism is required before such a balance can seriously be attempted. The relationship between mission requirements and the level of biological complexity of a closed ecological system is discussed.

Author

N63-15405 Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

A MICRO TECHNIQUE FOR BLOOD GROUPING INVESTIGATIONS

Edward S. Graff and Robert H. Edwards Sept. 1962 15 p 15 refs

(ARL-TDR-62-20)

A micromethod for hemagglutination reaction testing, including hemagglutinin adsorption, titer determination, and elution with minute quantities of blood, is described.

Author

N63-15448 General American Transportation Corp. Mechanics Research Div., Niles, Ill.

WASTE DISPOSAL FOR AEROSPACE MISSIONS Final Report [Mar. 1961-Aug. 1962]

P. P. Nuccio, C. M. Tomsic, and J. D. Zeff Wright-Patterson AFB, Ohio, Life Support Systems Lab., Jan. 1963 53 p 8 refs

(Contract AF 33(616)-8023)

(AMRL-TDR-63-4)

This report summarizes a program to develop a 3-man, laboratory-model, waste-disposal system for a 14-day aerospace mission. The program was divided into 2 phases. First, an experimental phase was undertaken to determine the thermal properties of the wastes using an experimental disposal system. The experimental phase determined that: (a) The specific heat of the wastes involved is 0.625 Btu/° F-lb. (b) The ignition temperature of the wastes is 700° F. (c) Incineration using pure oxygen at 160 mm Hg absolute generates 100 watts after ignition has been attained. (d) Thermal decomposition of the wastes requires a continuous input of 390 watts for 12 hours. Based upon the power requirements and a mass penalty of 0.15 pound/watt, incineration with pure oxygen was found to be the best waste-disposal technique for a 3-man, 14-day mission. In the second phase, the laboratory model was designed, fabricated, and tested. The complete system weighed 81 lbs and occupied 3.1 cubic feet. It was determined experimentally that a complete incineration cycle requires 2.6 kw-hr of electrical energy and ½ lb of oxygen, over a 12-hour period.

Author

N63-15490 Atomic Energy Commission. Div. of Technical Information, Washington, D.C.

PATHOANATOMICAL RADIATION-INDUCED CHANGES IN LUNGS (PATOLOGOANATOMICHESKIE IZMENENIYA LEGKIKH PRI LUCHEVOI BOLEZNI)

A. E. Ivanov 1961 126 p 126 refs Transl. from a publication of the State Publishing House for Medical Literature (Medgiz) Moscow, 1961

(AEC-TR-5500) OTS: $2.50

Anatomical changes in the lungs following radiation exposure are discussed and related to pathological conditions as well as subsequent infectious complications. The areas covered include inhalation of radioactive materials, whole body irradiation, histochemical analysis of lungs during radiation illness, and problems in pathogenesis.

R.C.M.

N63-15491 Atomic Energy Commission. Div. of Technical Information, Washington, D.C.

THE EFFECT OF IONIZING RADIATION ON VIRUS INFECTIONS AND ANTI-VIRUS IMMUNITY

O. P. Peterson, O. N. Berezina, I. A. Kozlova, and E. I. Sklyanskaya Feb. 1963 185 p 319 refs Transl. of "Vliyanie Ioniziruyuschego Izlucheniya na Virusnye Infektsii i Protivovirusnyi Immunitet" Moscow, State Publishing House of Medical Literature, 1961

(AEC-TR-5579) OTS: $2.75

It has been shown that, while uncontrolled ionizing radiation has a deleterious effect on the human body, with skillful utilization it can be used successfully both in medicine, for the diagnosis and treatment of certain diseases, and in various branches of science, for experimental and practical purposes. Cures for the exposure to ionizing radiation (radiation sickness) are now being sought, and ways of protecting the human organism against its harmful effects are needed. The contribution of acute and chronic radiation sickness to the natural resistance and acquired immunity of an organism to viral infections is found to be harmful and also increases the incidence and the seriousness of the disease.

D.E.R.

N63-15496 Pittsburgh U., Pa.

THERMAL STRESS ON CELLULAR STRUCTURE AND FUNCTION Final Report [Apr. 1961-July 1962]

Ralph Buchsbaum Wright-Patterson AFB, Ohio, Biomedical Lab., Feb. 1963 21 p 10 refs

(Contract AF 33(616)-8093)

(AMRL-TDR-63-14) OTS: $0.75

Mouse kidney cells were grown on coverslips in a specially designed perfusion chamber which permitted continuous change of medium, microscopic examination and photography, and precise temperature measurement and control. Cells were exposed to normal body temperature for a time and then to an elevated temperature for a period of one to ten minutes. The temperature then was returned to normal. Five stages of heat damage were distinguished in this cytosyndrome from normal to

death of the cells. For each observation, one hundred to one hundred fifty cells were each rated according to its appearance on a scale of five. Cells appear generally normal up to 42° C. Studies were made at 47°, 50°, 53°, and 56° C. The time to reach any stage of damage is a factor of about 4.5 for each 3° C increase in heat shock. The duration of exposure to elevated temperature was found not to be as important as the maximum temperature reached. A series of curves showing the distribution of cells in various stages of cell damage with temperature are presented. Author

N63-15510 National Aeronautics and Space Administration, Washington, D.C.

ON THE THEORY OF ELECTROPLETHYSMOGRAPHY (K TEORII METODIKI ELEKTROPLETIZMOGRAFII)

Yu. Ye. Moskalenko and A. I. Naumenko (First Leningrad Med. Inst. and Leningrad Electrotech. Inst.) May 1963 13 p 10 refs Transl. by Faraday Translations from Fiziol. Zh. SSSR (Moscow), v. 42, no. 3, 1956 p 312-316

(NASA TT F-157) OTS: $0.50

The extent of the changes in the electrical conductivity of the brain, in response to changes in the tonus of the brain vessels, was estimated by means of calculations in which the brain and its vascular and arachnoid members are approximately represented in a geometrical form convenient for mathematical analysis. On the basis of the computations, it was possible to estimate the relative changes in the amount of cerebrospinal fluid in the cranial cavity. Author

N63-15511 National Aeronautics and Space Administration, Washington, D.C.

MECHANISM OF VENOUS OUTFLOW FROM THE CRANIUM (O MEKHANIZME VONOZNOGO OTTOKA KROVI IZ CHERPA)

A. A. Kedrov, A. I. Naumenko, and Z. Ya. Degtyareva (I.L. Pavolov First Leningrad Med. Inst.) May 1962 9 p 10 refs Transl. by Farady Translations from Byull. Eksptl. Biol. i Med. (Moscow), no. 9, 1957 p 10-14

(NASA TT F-163) OTS: $0.50

Data obtained from investigations on six canine subjects indicated that the registration of pulse acceleration in the outflow of blood from cranial sinuses can be used as a method of investigating intercranial circulation. This method has the advantage that it does not require opening the cranial cavity; thus, hermetic conditions need not be disturbed. Author

N63-15518 Naval Radiological Defense Lab., San Francisco, Calif.

BEHAVIORAL AROUSAL AND NEURAL ACTIVATION AS RADIOSENSITIVE REACTIONS

E. L. Hunt and D. J. Kimeldorf Feb. 27, 1963 53 p 79 refs

(USNRDL-TR-624)

In a study designed to detect prompt reactions to ionizing radiation, rats were exposed to 250-kvp X-rays, and measurements of behavioral departures from sleep and of heart rate were used to indicate activation of the central nervous system. Exposure at a low dose rate (0.25 r/sec) produced a transitory arousal from sleep within the first 12 seconds (accrued dose of 3 r). At a higher dose rate (1.9 r/sec) this initial reaction increased in scope and, by 30 seconds, included also an acceleration in heart rate. Only animals exposed at the higher dose rate exhibited evidence of excitation during the residual period of exposure to a 1,000-r total dose. Accordingly, the intensity of the reaction during exposure depended upon the dose rate rather than the total dose. A transient excitatory effect at the termination of exposure was indicated by the occurrence of behavioral wakefulness for a period of minutes following exposure at both dose rates. The excitatory effects of irradiation were not dependent upon adrenal function since adrenalectomized animals showed a sequence of reactions comparable to that shown by normal animals but with longer latencies. Stimulation through radiosensitive mechanisms, apart from the visual receptor system, was indicated since opthalmectomized animals exhibited both behavioral and heart-rate responses within seconds after the start of exposure. Some possible modes for the action of ionizing radiation as a stimulus to the nervous system are discussed. Author

N63-15560 Naval Radiological Lab., San Francisco, Calif.

MUTUALLY TOLERANT HOST AND DONOR TYPE IMMUNOLOGICALLY COMPETENT CELLS IN MOUSE RADIATION CHIMERAS

W. E. Davis, Jr., M. L. Tyan, and L. J. Cole Mar. 19, 1963 22 p 20 refs

(USNRDL-TR-630)

Host type immunologically competent cells were found in 4 out of 15 LAF_1 (host)–C3H (donor) long-lived radiation mouse chimeras. Three of these 4 chimeras also had donor type lymphoid cells. Therefore, the host and donor immunocompetent cells must have coexisted in a state of mutual homograft tolerance. Of the remaining 11 chimeras tested, 6 did not exhibit host type immunocompetent cells, while 5 showed questionable host-derived immunological activity. Donor immunocompetent cells were detected in a total of 4 of the 15 LAF_1–C3H chimeras. Host type (i.e., strain A) immunocompetent cells were detected also in two A–LAF_1 radiation chimeras. On the other hand, 10 C3H–$C3D2F_1$ radiation chimeras apparently did not contain host-derived immunogenic cells. The presence of hematopoietic cells of host origin was detected in 4 out of 15 LAF_1–C3H radiation chimeras. Host-derived hematopoietic cells were not detected in the A–LAF_1 radiation chimeras, and only 1 of the 10 C3H–$C3D2F_1$ radiation chimeras had host hematopoietic tissue. Therefore, within the limits of the test system employed, the hematopoietic cells in the remaining chimeras must therefore be predominantly of donor origin. Author

N63-15620 Bendix Corp. Pioneer-Central Div., Davenport, Iowa

CAPILLARY ACTION LIQUID OXYGEN CONVERTER FOR WEIGHTLESS ENVIRONMENT [Final Report, May 1, 1961-Aug. 25, 1962]

Duane E. Hinds and John Cleveland Wright-Patterson AFB, Ohio, Life Support Systems Lab., Jan. 1963 22 p 2 refs

(Contract AF 33(616)-8185)

(AMRL-TDR-63-10)

A 25-liter, capillary-action liquid-oxygen converter has been fabricated to incorporate all the components required to provide a completely operational, self-contained system to supply breathing oxygen in a weightless environment. The converter design of functional components and the principle of operation has combined the forces of surface tension, wetting, and capillary action of liquid oxygen to provide adequate forces to ensure satisfactory operation of the system during space environments. These forces will provide for the expulsion of liquid oxygen under standard conditions, during acceleration forces up to and including 14 G, and in the zero-gravity condition. The report includes all the test data and results of the complete development program and the physical arrangement required for the capillary action converter system. The testing which could be accomplished in the laboratory gave every evidence that the design concept is satisfactory for zero-gravity operation. Author

N63-15646 John B. Pierce Foundation of Connecticut, Inc., New Haven

HYPOTHALAMIC TEMPERATURES IN DOG AND MONKEY AND THERMOREGULATORY RESPONSES TO ENVIRONMENTAL FACTORS [Final Report, Oct. 1961-Nov. 1962]

Harold T. Hammel, Donald C. Jackson, Johannes A. J. Stolwijk, and James D. Hardy Wright-Patterson AFB, Ohio, 6570th Aerospace Med. Res. Labs., Jan. 1963 34 p 26 refs

(Contract AF 33(657)-7603, and AF 33(616)-6306)

(AMRL-TDR-63-5) OTS: $1.00

The role of the hypothalamic and skin temperatures in controlling the thermal response of a resting animal was studied by measurements of (1) hypothalamic, rectal, ear-skin and trunk-skin temperatures on the resting dog and rhesus monkey (hypothalamic temperature only) in hot, neutral, and cold environments; and (2) the thermal and metabolic response of a dog while holding hypothalamus at approximately 38.7° C by means of six thermodes surrounding the hypothalamus and perfused with water. The results indicate that the parameters involved in temperature regulation must include more than skin and hypothalamic temperatures, since an animal engaged in normal regulation would exhibit very different responses for the same hypothalamic temperature when exposed to different ambient temperatures, or would exhibit the same responses at widely different hypothalamic temperatures at different times, depending on whether asleep or awake. The discussion of these results includes a hypothesis of a dependent set point which suggests that the set point for temperature regulation depends upon the skin temperature, extra-hypothalamic core temperatures, whether the animal is asleep or awake, and other factors. Author

N63-15658 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio

THE FIRST MANNED SPACE FLIGHTS

Yu. M. Volynkin, V. I. Yazdovskiy et al (Acad. of Sci. USSR) Dec. 7, 1962 251 p Transl. from the book "Pervyye Kosmicheskiye Polety Cheloveka", Mediko-Biol. Issledovaniya (Moscow), 1962

(FTD-TT-62-1619/1+2)

Results of medical and biological investigations of Yu. A. Gagarin and G. S. Titov during their spaceflights in Vostok and Vostok-2 are presented. The life support and recovery systems of the Vostok spacecraft are described, and the preflight cosmonaut training and conditioning techniques are discussed. The results of preflight and postflight medical examinations are compared, and the methods and results of physiological monitoring of the cosmonauts' responses during spaceflight are included. Neither of the cosmonauts received a significant dose of ionizing radiation, their efficiency was not disturbed, and they experienced no difficulty in eating, drinking, sleeping, and urinating. Titov did experience vestibular-vegetative disturbances, but no conclusion concerning the universality of vestibulary reactions during prolonged spaceflight can be made from this single observation. M.P.G.

N63-15665 Rand Corp., Santa Monica, Calif.

ANALYSIS OF CHEMICAL CONSTITUENTS OF BLOOD BY DIGITAL COMPUTER

James V. Maloney, Jr., James C. De Haven, Edward C. De Land and Gilbert B. Bradham Apr. 1963 40 p 13 refs Presented at the 24th annual meeting of The Soc. of Univ. Surgeons, Seattle, Feb. 8, 1963

(Contract AF 49(638)-700; PHS Grants H-2812 and HTS-5357; Proj. RAND)

(RM-3541-PR)

Programing techniques have been used to construct a computer simulation of the biochemical behavior of human blood. Changes in concentration of some 56 different constituents of plasma, erythrocytes, and alveolar gas can be determined by the computer model when it is subjected to various simulated stresses. A blind competition between the computer and a team of physicians and chemists was conducted on the blood chemistry alterations associated with alkalosis, hypothermia, respiratory acid-base problems, saline infusion, hyperbaric oxygenation, and metabolic acidosis. The computer model was found to be correct in every case. Although the digital equipment is expensive, the cost of a complete blood study using the computer is only $10. M.P.G.

N63-15666 Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

A MULTIPLE AVOIDANCE SCHEDULE FOR MEASURING TEMPORAL PROCESSES IN THE CHIMPANZEE Technical Documentary Report

Herbert H. Reynolds, Victor Bogo, and Frederick H. Rohles Apr. 1963 13 p 7 refs

A three-component multiple-shock-avoidance schedule for measuring different types of temporal discrimination is described and data are presented for a chimpanzee. On the first component, FR-1 (15 in. to 30 in.) avoid. shock can be avoided by delaying a single response until between the 15th and 30th second after the presentation of a cue light; in the second component, FR-20 (0 in. to 20 in.) avoid. shock can be avoided by making 20 lever presses within 20 seconds; and in the third component FR-1 (0 in.to 2 in.) avoid. shock can be avoided by making one lever press within 2 seconds after the presentation of a visual cue. Author

N63-15707 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SPACECRAFT LIFE SUPPORT SYSTEMS

Dan C. Popma [1963] 18 p Presented at the Inst. of Electrical and Electronics Engrs. Region 3 Meeting, Richmond, Va., Apr. 24–26, 1963

(Paper CP-63-693) OTS: $1.60 ph, $0.80 mf

Requirements of life support for the crew members of manned spacecraft are considered in relation to man's metabolic requirements and metabolic products. Appropriate methods and equipment are related to these requirements and the characteristics of various manned space missions. Among the provisions required for maintaining physical well-being are systems for (1) the removal of carbon dioxide, (2) the reclamation and supplying of oxygen, (3) the control of temperature, humidity, and toxic gases, (4) the reclamation of water, (5) the management of wastes, and (6) the supplying of food. Some of the research being performed at the Langley Research Center with life-support systems is discussed, and the research objectives are stressed. Descriptions are given of the various types of equipment used in this research, together with criteria for system evaluations. Author

17 MACHINE ELEMENTS AND PROCESSES

Includes: bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; and materials fabrication, handling, and inspection.

For related information see: 06 Auxiliary Systems.

N63-15249 General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio

LOW VISCOSITY BEARING STABILITY INVESTIGATION Second Quarterly Project Status Report for Period Ending May 9, 1962

[1962] 70 p 5 refs

(NASA Contract NAS3-2111)

OTS: $6.60 ph, $2.30 mf

Seven types of turbomachinery bearings have been investigated on a high-speed test rig to determine which configurations satisfy the spaceflight requirements of long-term unattended operation with low viscosity lubricants under zero g conditions. Zero-load radial-film stiffness and static load-carrying ability were studied for the following configurations: (1) two-groove cylindrical bearing; (2) preloaded cylindrical bearing (nut cracker); (3) orthogonally displaced elliptical bearing; (4) compound cylindrical bearing; (5) three-lobe bearing; (6) tilting pad bearing; and (6) Rayleigh step bearing. The effect of arbitrary load vector position relative to bearing geometry was also included in these studies. M.P.G.

N63-15272 General Plastics Corp. Bloomfield, N.J.

PRODUCTION OF THIN POLYTETRAFLUOROETHYLENE RESIN (TEFLON) COATINGS BY ELECTRODEPOSITION METHODS Final Report, Mar. 19, 1962 to Mar. 19, 1963

Robert W. Logan [1963] 76 p 33 refs
(Contract Now-62-0600-C)

An electrodeposition method of applying thin polytetrafluoroethylene resin ("Teflon") coatings has been developed which allows the application of crack-free films up to 0.001 in. thick in one coating operation. Polytetrafluoroethylene (TFE) coatings applied by this method are intended to supplement sprayed TFE coatings in lubricating, without the use of oils or greases, a wide variety of military equipment. Electrodeposited TFE coatings possess a very low coefficient of friction on steel, are smooth and free from blisters, cracks, coagulated particles and other surface defects, and exhibit adhesion (under simulated dry-lubricant conditions) comparable to sprayed TFE coatings. The electrodeposition process will allow the coating of parts or equipment that heretofore were difficult, if not impossible, to spray. In addition, due to the generally favorable edge in the economics of the electrodeposition process vs. the spray process, TFE may now be applied to parts which previously were not economically feasible to coat. The main limitation of the electrodeposition process is that only those metals which are anodically corrodible and which can withstand the 700° to 750° F sintering temperature can be coated. This eliminates aluminum, stainless steel, and zinc, among others. Author

N63-15409 Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S.C.

AUTOMATIC CRANE CUTOFF DEVICE

Whitfield F. Woodhead Feb. 1963 15 p 1 ref
(Contract AT(07-2)-1)
(DP-820) OTS: $0.50

An overload safety device was designed to prevent the cable of a traveling crane from breaking when the load is snagged. When an overload occurs, a spring-mounted pulley deflects and actuates limit switches to shut off the crane and hoist motors. To accommodate inertial motion of the crane, the pulley will deflect about 8 inches before the load limit of the cable is reached. Author

N63-15420 Ohio State U. Research Foundation, Columbus

NONDESTRUCTIVE SYSTEM FOR INSPECTION OF FIBER GLASS-REINFORCED PLASTIC MISSILE CASES Third Quarterly Technical Report [Jan. 2, 1962-Mar. 28, 1962]

Merle Rhoten, Jay P. Mitchell, and Robert C. Mc Master Apr. 20, 1962 17 p
(Contract DA 33-019-ORD-3670)
(WAL TR 142.5/2-1)

The purpose of this research program is to develop a television X-ray imaging system for the nondestructive inspection of fiber glass-reinforced-plastic missile-case walls and materials. In an effort to determine the effect of thinner target materials, a beryllium-window vidicon tube was fabricated with a target material thickness of 15 microns. Images produced with this tube show extremely good definition and contrast. The image lag prevented in-motion viewing. After a short period of time, spots developed on the target and it was impossible to resolve a 60-mesh screen. Author

N63-15493 Value Engineering Co., Alexandria, Va.

RESEARCH AND DEVELOPMENT ON ELECTRODEPOSITED COATINGS FOR HIGH TEMPERATURE EXPERIMENTAL SOLID PROPELLANT ROCKET NOZZLES Sixth Quarterly Report, 30 Sept.-29 Dec. 1962

E. Goodman and R. Thompson Jan. 29, 1963 18 p
(Contract DA 36-034-ORD-3497 RD)

The program to further develop and adapt an electrodeposited cermet (chromium base) for the protection of solid propellant rocket nozzles is summarized. The work includes the X-ray analysis of a group of coated copper samples for their fluorescence and diffraction properties, the calibration of the hydrogen-oxygen rocket engine, and a study of the nozzle configuration used. D.E.R.

N63-15508 Westinghouse Electric Corp., Elmira, N.Y.

STUDY ON MATERIAL INTERACTION AND MIGRATION IN CAMERA TUBES [Final Summary Report, Dec. 1, 1960-Nov. 30, 1961]

Vert Upshaw Wright-Patterson AFB, Ohio, Electronic Technol. Lab., Apr. 1962 42 p 3 refs
(Contract AF 33(616)-7723)
(ASD-TDR-62-78)

To study the interaction and migration of materials in camera tubes, the image orthicon target was selected. A demountable structure was built incorporating matrix cathodes for target testing. The demountable seal permitted conventional exhaust and test processing without special equipment. Storage tests on aluminum oxide targets in tubes made without alkali showed resolution of better than 500 lines after an image storage time of ninety minutes. Author

N63-15548 Narmco Research and Development. Div. of Narmco Industries, Inc., San Diego, Calif.

TUNGSTEN TO GRAPHITE BONDING Final Technical Report

J. Ralph Armstrong and Roger A. Long Sept. 30, 1962 26 p 1 ref
(Contract DA-04-495-ORD-3028)

Tungsten-to-graphite carbide-based bonds, developed under a previous phase of this program, were evaluated as to tensile strength vs. temperature and thermal-shock resistance. Tensile strengths varied from 530 psi at room temperature to 193 psi at 4000° F. No thermal-shock failures were observed under the test conditions: 3500° F in ten seconds to a maximum temperature of 4425° F, followed by cooling to below red heat in 15 seconds. Author

N63-15558 Mound Lab., Miamisburg, Ohio

MOUND LABORATORY PROGRESS REPORT FOR NOVEMBER 1962

J. F. Eichelberger, G. R. Grove, L. V. Jones, and E. A. Rembold May 8, 1963 41 p 1 ref
(Contract AT-33-1-GEN-53)
(MLM-1145)

Preliminary results of research and development is reported in the following areas: radioelements; isotope separation and purification; alpha and neutron source development; reactor fuels and materials research; and chemical analysis. M.P.G.

N63-15675 Hanford Atomic Products Operation, Richland, Wash.

PRTR MECHANICAL SEAL PUMP OPERATING EXPERIENCE

P. A. Scott Apr. 23, 1963 32 p 1 ref
(Contract AT(45-1)-1350)
(HW-76646) OTS: $0.75

The two-year operating experience of the primary pump of the Plutonium Recycle Test Reactor (PRTR) is described. Twenty operating runs for the four available primary coolant pump units are reported; fifteen of these runs were terminated because of failure of the high-pressure mechanical seals after an average operating time of 1250 hours. The last completed run of each pump averaged 2050 hours. The reactor pump in the primary loop mockup had operated for 7197 hours without primary seal face failure when the final test run was discontinued. Maintenance and operational problems encountered included gas evolution due to helium pressurization of the PRTR, and seal life reduction under alternate low-pressure high-pressure operation. No recent failures are attributed to vibration. Final test runs indicate that pump operating periods of 1 to 2 years are feasible with complete bowl venting and seal design for low-pressure operation. M.P.G.

N63-15684 General Motors Corp. New Departure Div., Bristol, Conn.

RESEARCH AND DEVELOPMENT OF AIRFRAME BEARINGS FOR AEROSPACE VEHICLES Progress Report No. 1 [May 1-July 31, 1962]

R. J. Matt, J. B. Muratore, R. E. Murteza, and C. J. Zupkus Aug. 1, 1962 50 p 18 refs

(Contract AF 33(657)-8431)

Rolling and sliding contact bearing specimen materials have been selected for Phase 1 experiments. Several groups have been fabricated. The rolling and sliding specimen test rigs for temperatures of from −100° F to 2,000° F have been designed and built. The test rig for temperatures up to 2,500° F has been designed. Test conditions have been defined, and preliminary static indentation tests will be run to determine maximum load capacities of representative superalloy, cermet, and ceramic materials. Candidate lubricants and lubricating techniques for Phase 2 experiments are being studied. Author

N63-15716 General Motors Corp. Allison Div., Indianapolis, Ind.

CONTINUATION OF 3-KW STIRLING CYCLE SOLAR POWER SYSTEM PROGRAM, PHASE II Technical Progress Report, 1 May 1961 through 28 Feb. 1962

D. S. Monson Mar. 26, 1962 195 p refs

(Contract AF 33(616)-8332)

(Engineering Dept. Rept. 2628)

Continued testing of the PD-46 research Stirling engine, directed toward evaluation of modifications which might be incorporated in the design of a flight-type power system, is discussed. This program resulted in a 28.5-percent improvement in power output and a 12-percent improvement in efficiency. This gain resulted from reductions in piston seal leakage, dead volume, crankcase friction, and working fluid pressure losses. Tests of a zero "g" lubrication system in an ASD weightless research aircraft are discussed. Design of the major components of a flight-type engine has been completed and fabrication is in process. Author

N63-15739 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux

ÉTUDE ET RÉALISATION D'UN MICROTEST DES CARACTÉRISTIQUES MÉCHANIQUES ET DU COMPORTEMENT RHÉOLOGIQUE DES RÉSINES POLYMÉRES [DESIGN AND CONSTRUCTION OF A MICROTESTING DEVICE TO DETERMINE THE MECHANICAL CHARACTERISTICS AND THE RHEOLOGICAL BEHAVIOUR OF POLYMER RESINS]

Anatole Popoff and René Caze Feb. 1963 34 p 1 ref In French; English Summary

(ONERA Tech. Note 71)

A description is given of a microtest applicable to high polymers to determine their mechanical strength, stiffness modulus, hysteresis, and failure plasticity from samples of a few milligrams only. The testing method and the torsion device are also described. A relation can be established between the resin's characteristics and their shear strength when they are used as adhesives or when they are to be associated with cloth or fiber glass with a view to obtaining reinforced plastics. Author

N63-15760 Republic Aviation Corp. Missile Systems Div., Mineola, N.Y.

EVALUATION OF HIGH-STRENGTH LIGHTWEIGHT LAMINATED PRESSURE VESSELS OF LAP-JOINT CONSTRUCTION Third Quarterly Progress Report, June 1-Aug. 31, 1962

R. E. Stegler Watertown, Mass., Watertown Arsenal Labs., Oct. 16, 1962 45 p

(Contract DA-30-069-ORD-3440)

(WAL-TR-766.2/3-2)

Test quantities of 18-9-5 Ni Co Mo (INCO 300 KSI) steel were evaluated, and the subscale ring-sizing investigation was completed. Fulsize ring fabrication criteria were established by extrapolation. The lap-shear test program is nearly completed for the 0.025- and 0.064-inch thicknesses of material. Pressure vessel designs were established for these two gages, and design values were interpolated for the 0.040-inch material (Subject to confirmation tests). The first quantities of the production material were delivered for evaluation of specification deviation effects. Tool design and fabrication were completed. Author

18 MATERIALS, METALLIC

Includes: cermets; mechanical and physical properties of alloys and metals; and metallurgy.

***For related information see:* 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Non-metallic; 33 Stresses and Loads; and 34 Structural Design.**

N63-15252 France. Ministère de l'Air, Paris

SUR LA STRUCTURE DE L'INTERFACE FER-OXYDE DE FER ET SUR L'INSOLUBILITÉ DE L'OXYGÈNE DANS LE FER DE HAUTE PURETÉ [ON THE STRUCTURE OF THE FERROUS-OXIDE INTERFACE OF IRON AND ON THE INSOLUBILITY OF THE OXYGEN IN IRON OF HIGH PURITY]

Raymond Sifferlen Paris, Service de Documentation et d'Information Technique de l'Aéronautique (SDIT), [Oct.] 1961 74 p 41 refs In French

(*Its* Publications Scientifiques et Techniques, N.T.-104) Available from SDIT, 2, Ave. de la Porte d'Issy, Paris (15e)

The oxidation of iron is studied from the standpoint of an interfacial reaction and the structure of the resulting iron oxide on the surface is investigated. A protoxide of iron is found to be formed and its structure and formation under different conditions are studied. The influence of impurities at the surface on the oxidation rate of iron is tabulated, and an electron microscopic study of the iron oxygen interface is made. Finally, a study is made of the solubility of oxygen in iron of high purity. Trans. by D.E.R.

N63-15253 Battelle Memorial Inst., Columbus, Ohio

THE VISCOSITY OF SATURATED LIQUID POTASSIUM FROM 70° TO 1150° C BY THE OSCILLATING-CYLINDER METHOD Topical Report

Elton H. Hall and John M. Blocher, Jr. Aug. 31, 1962 28 p 31 refs

(NASA Contract NAS5-584)

(BATT-4673-TI) OTS: $2.60 ph, $1.04 mf

An oscillating-cylinder viscometer has been designed and constructed which is suitable for the measurement of the viscosity of liquids, particularly liquid metals, over an extended range of temperature. The apparatus has been used to measure the viscosity of liquid potassium from 70° to 1150° C. The results tend to fall between the extremes of previously reported values. Author

N63-15255 Ladish Co. Government Relations Div., Cudahy, Wis.

INVESTIGATION OF THE EFFECTS OF MELTING PROCESSES UPON THE TRANSVERSE DUCTILITY OF H-11 STEEL AT HIGH STRENGTH LEVELS Interim Engineering Report No. 2, May 18, 1961 to Nov. 18, 1961

Joseph C. Truszynski, Carl Luger and Jack A. Yoblin May 1962 483 p refs

(Contract AF 33(600)-38767)

(ASD-TR-7-678(III))

Transverse ductility of electric-furnace air melt and vacuum-arc remelt H-11 steels, strength range 280 to 300 ksi, was compared by means of statistical analysis of 4127 sets of tensile-test data obtained from six mills and contractor's records. Analysis of the data, representing 502 heats, established that remelt material (1) exhibits a superior strength–ductility relationship in all billet sizes of each mill, irrespective of test location and (2) displays a greater uniformity of properties. Findings were augmented by contractor tests above 300 ksi. Author

N63-15279 Frankford Arsenal. Pitman-Dunn Labs., Philadelphia, Pa.
TRANSITION PHASE IN Mg-14Li-1Al-1Zn ALLOY Technical Report
James V. Rinnovatore and Milton Schwartz Feb. 1962 24 p 7 refs
(FA-R-1623)

Mechanical property studies and X-ray diffraction work were performed on three Mg-Li base cast alloys (Mg-14Li-1Al-1Zn, Mg-13.6Li-4Al-1Zn, and Mg-14.1Li-1Al). Tensile properties of the alloys in the following conditions were determined: cast; cast and aged; and cast, solution treated, and aged. Debye-Scherrer X-ray diffraction patterns were taken of all alloys in the various conditions. A transition-type phase was detected in the two quaternary alloys. X-ray diffraction lines from this phase corresponded to an Fd. (Fd3 or Fd3m) space group with a lattice parameter of approximately 6.7Å. Prolonged aging at 200° F resulted in the transformation of this phase to the stable AlLi compound. This phase was not detected in the ternary alloy, but prolonged aging produced the AlLi phase. Author

N63-15365 Hanford Atomic Products Operation, Richland, Wash.
GAS-METAL REACTIONS WITH IRON- AND NICKEL-BASE HEAT RESISTANT ALLOYS An Interpretive Literature Survey
D. A. Jones Mar. 1963 22 p 33 refs
(Contract AT(45-1)-1350)
(HW-76952) OTS: $0.50

A literature survey is presented concerning the compatibility of stainless steels and nickel-base alloys with various gases which might be in or around a high-temperature nuclear reactor. The gases considered are oxygen, air, nitrogen, carbon monoxide, and carbon dioxide. The trade names and compositions of the alloys surveyed are listed. Physical metallurgy of heat-resistant alloys is discussed, and the general theory of alloy oxidation is reviewed. R.C.M.

N63-15366 Naval Research Lab., Washington, D.C.
EFFECTS OF SPEED AND TEMPERATURE ON CRACK TOUGHNESS AND YIELD STRENGTH IN MILD STEEL
J. M. Krafft and A.M. Sullivan Apr. 30, 1962 24 p 15 refs
(NRL-5776) OTS: $0.75

Plane-strain crack toughness evaluated with sharply notched rounds is compared with dynamic yield strength measured with compression specimens for three steels of varied notch-bar impact characteristics, over a wide range of temperatures (+200° to −320° F) and loading rates (10^2 to 10^7 psi/sec). It is determined that the upper yield strength σ_{uys}, applicable for loading speeds which would be present about 0.001 in. from the crack tip, assuming an elastic stress field, is related to the plane-strain crack toughness K_{Ic}^{*} by $K_{Ic}^{*} = M\,\sigma_{uys}^{-1.5}$, where the proportionality constant M increases with notch impact performance. Interpretation of notch-beam impact tests (Charpy) and of crack-propagation results from wide-plate tests, in terms of K_{Ic}^{*} estimated from yield strength, is quite promising. Author

N63-15378 Bureau of Mines, Washington, D.C.
MAGNETIC SUSCEPTIBILITY OF SIDERITE
H. E. Powell and C. K. Miller 1963 23 p 18 refs
(BM-RI-6224)

A laboratory investigation was conducted by the Bureau of Mines to study the magnetic characteristics and to measure the magnetic susceptibility of the mineral siderite. All susceptibility measurements were made by the method of Gouy, on powdered samples and at room temperature. Specific susceptibilities of samples from 15 different locations, domestic and foreign, were determined. Values ranged from 66 to 103 (10^{-6}) cgs electromagnetic units. The relation of susceptibility to mineral composition is discussed in this report. The specific susceptibilities of 76 minerals are tabulated. Author

N63-15380 Argonne National Lab., Ill.
LAMB WAVES: THEIR USE IN NONDESTRUCTIVE TESTING [Status Report]
Roberta Ann di Novi Mar. 1963 22 p 19 refs
(Contract W-31-109-eng-38)
(ANL-6630)

A series of experiments which were primarily concerned with establishing the usefulness of Lamb waves for the detection of small defects in thin plates and in small-diameter, thin-walled tubing are described. Included are the theoretical aspects and experiments on plates, tubes, longitudinal flaws, and transverse flaws. The tests indicate that, as a nondestructive testing tool, Lamb waves can offer a greater sensitivity and resolution than the more conventional shear waves, and that the critical alignment problem, which is the main disadvantage to using Lamb waves, may be compensated for by this sensitivity. D.E.R.

N63-15383 Little (Arthur D.) Inc., Cambridge, Mass.
BASIC PARAMETERS OF METAL BEHAVIOR UNDER HIGH RATE FORMING. UNIFORM ELONGATION TO FAILURE AT HIGH RATES OF STRAIN Second Interim Report to Watertown Arsenal Laboratories
P. C. Johnson, B. A. Stein, and R. S. Davis June 1962 33 p 1 ref
(Contract DA-19-020-ORD-5239)
(WAL-TR-111.2/20-1)

Using the dynamic expansion of a ring, the uniform elongation to failure at high rates of strain has been measured for seven materials, by measuring the change in grid spacing on one surface of fractured rings. Values obtained using a mean, initial strain rate of the order of 10^3 per second are compared to the values obtained on specimens pulled to fracture at a mean strain rate of 10^{-3} per second. The dynamic uniform elongation to fracture was greater than the quasi-static value for materials of low ductility and somewhat less than the quasi-static value for the materials of high ductility. Author

N63-15397 Battelle Memorial Inst., Columbus, Ohio
ENGINEERING PROPERTIES OF POTASSIUM Ninth Quarterly Report, Oct. 1 through Dec. 31, 1962
Alexis W. Lemmon, Jr. Jan. 30, 1963 17 p 7 refs
(NASA Contract NAS5-584)
OTS: $1.60 ph, $0.80 mf

The thermodynamic and transport properties of potassium are being determined in the temperature range of 900 to 2100 degrees F. Measurements of the viscosity, vapor pressure, and enthalpy of liquid potassium have been concluded, and the thermal conductivity and electrical resistivity have been measured up to 800°C. Pressure–volume–temperature equipment has been calibrated, and equipment for the determination of the specific heat has been designed. A bare wire-probe dynamic method for measuring the thermal conductivity of potassium vapor has been devised and equipment is being designed. D.E.R.

N63-15398 Bureau of Mines, Washington, D.C.
LEAD AND BARIUM DISILICIC FLUORMICAS
John L. Miller, Jr., I. L. Turner, and H. R. Shell 1963 13 p 6 refs
(BM-RI-6228)

The synthetic fluormicas may be divided on the basis of silicon content into tetrasilicic, trisilicic, and disilicic. Properties of lead and barium disilicic fluormicas were determined to characterize these two representative members of the disilicic group. Properties described include unit-cell parameters from X-ray diffraction, optical data, chemical composition, density, melting point, and mechanical and dielectric properties. Both the lead and the barium micas were typically monoclinic; neither was sufficiently cleavable to yield usable mica splittings. Both yielded polycrystalline, machinable ceramics with excellent mechanical and dielectric properties.

Author

N63-15402 Naval Air Material Center. Aeronautical Materials Lab., Philadelphia, Pa.

INVESTIGATION OF SPOT WELDING CHARACTERISTICS OF TITANIUM ALLOYS

Edward F. Deesing Nov. 28, 1961 24 p

(NAMC-AML-1319)

The fatigue strength of multiple spot-welded joints in .060-in. thick sheet material of the titanium alloys 4A1-3Mo-IV, 16V-2.5A1, and 6A1-4V were determined. The fatigue strength of the three alloys was found to be 8 to 10% of the static strength of the spot-welded joint. The alpha-beta alloy 4A1-3Mo-1V had the highest fatigue strength; the 16V-2.5A1, all beta alloy, the lowest. Data are also presented on the elevated-temperature strength of spot welds and the effect of exposure to elevated temperature on room-temperature strength of spot welds in the 4A1-3Mo-1V alloy. A uniform decrease in shear strength was noted with increase in temperature. At an exposure temperature of 600° F, the 4A1-3Mo-1V alloy retained its strength up to 250-hrs. exposure time. A uniform decrease in shear strength occurred after exposure at 900° F for 100 hrs., but an anomalous increase in strength occurred after exposure of 1000 hrs.

Author

N63-15403 European Atomic Energy Community, Brussels (Belgium)

LE DOSAGE DU SILICIUM ET DU COBALT DANS LES ACIERS INOXYDABLES PAR SPECTROGRAPHIE DES RAYONS X (QUANTITATIVE ANALYSIS OF SILICON AND COBALT IN STAINLESS STEELS BY X-RAY SPECTROGRAPHY)

W. De Spiegeleer, C. Toussaint and G. Vos Joint Nuclear Research Center, Ispra Estab. (Italy), Chem. Serv. [Mar.] 1963 11 p 5 refs

In French; English summary

(EUR-203.f) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86: 25 Belg. Fr.

The determination by X-ray spectrography of silicon and cobalt in stainless steel is made by using National Bureau of Standards' standards. In the case of cobalt, we use the second order K α line and introduce a correction for the matrix influence. The standard is a low-alloy steel. The limits of sensitivity are for Co 0.005% and Si 0.02%.

Author

N63-15404 Knolls Atomic Power Lab., Schenectady, N.Y.

MECHANICAL PROPERTIES OF ZIRCALOY-2–NIOBIUM-OXYGEN ALLOYS

A. E. Bibb and J. R. Fascia Jan. 15, 1963 25 p 6 refs

(Contract W-31-109-eng-52)

(KAPL-2252) OTS: $1.00

Zircaloy-2, the most commonly used zirconium alloy in nuclear-reactor application, combines the attractive characteristics of low neutron absorption, good corrosion resistance in water at elevated temperature, and adequate mechanical properties at moderately high temperatures. Additions of niobium and oxygen produce an increase in mechanical strength to temperatures on the order of 500° C. This increased strength is accompanied by adequate ductility, especially above 375° C. Plateaus in the strength-vs.-temperature curves between 300° and 500° C are attributed to pinning of dislocations by tin atoms, similar to the strain-aging concept. Heat treatment affects both the structure and mechanical properties of these alloys. Notched tensile tests, performed at elevated temperatures, showed all alloy compositions to be notch insensitive at temperatures above 450° C; however, certain combinations of high niobium (7.5 wt %) and high oxygen (2500 ppm) were notch sensitive below 288° C.

Author

N63-15411 Armour Research Foundation, Chicago, Ill.

DEVELOPMENT AND APPLICATION OF A THEORY FOR PLASTIC DEFORMATION OF CEMENTED ALLOYS. COPPER-COOLED TUNGSTEN FIBER ROCKET NOZZLE MATERIALS Quarterly Report, Oct. 1, 1961–Dec. 31, 1961

T. J. Koppenaal Jan. 29, 1962 12 p

(Contract DA-11-022-505-ORD-3092)

(WAL-TR-372/32-3-T1)

The copper-nickel ratio used as a matrix material has been investigated in 75%-density tungsten-fiber composites made from one- and two-mil-diameter fibers. The ductility in tension and compression was evaluated. The use of Si as an additive to the matrix was examined in an attempt to improve the ductility in tension.

Author

N63-15417 Mellon Inst., Pittsburgh, Pa.

STRESS CORROSION OF HIGH STRENGTH STEELS AND ALLOYS; ARTIFICIAL ENVIRONMENT Final Report, July 1, 1960–June 30, 1962

C. J. Owen [1962] 122 p refs

(Contract DA-36-034-3277RD)

A study of the susceptibility of various high-strength missile materials to stress corrosion cracking in a number of synthetic environments was performed. The various high-strength steels and other high-strength alloys investigated included D6Ac, 300M, Vascojet-1000, AM355, PH15-7Mo, B120VCA, 4137Co, Ardeform 301, and Rocoloy 270. In general, in these tests, all low-alloy martensitic steels showed a susceptibility to stress-corrosion failure in varying degree, D6Ac being the least susceptible and Vascojet 1000 being the most susceptible. Of the higher alloy samples, AM355 and Ardeform 301 showed a possible susceptibility in the synthetic chloride environment. The PH15-7Mo and B120VCA were not found to be prone to stress-corrosion failure. A decarburized surface was found to decrease failure-rate in U-bends by several orders of magnitude, and alloying with uranium effected a U-bend failure-rate decrease of well over one order of magnitude. In general, organic coatings were not too effective in inhibiting stress-corrosion failure, one or two coatings being somewhat superior to the others. The more promising combinations of coating variables are indicated.

Author

N63-15431 Southwest Research Inst., San Antonio, Tex.

DETERMINATION OF THE EFFECTS OF ELEVATED TEMPERATURE MATERIALS PROPERTIES OF SEVERAL HIGH TEMPERATURE ALLOYS [Final Report, Mar. 1960–Oct. 1961]

M. M. Lemcoe and Alex Trevino, Jr. Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, June 1962 396 p 12 refs

(Contract AF 33(616)-7056)

(ASD-TDR-61-529)

This investigation was conducted to determine mechanical properties of several high-performance alloys at room and elevated temperatures. The effects of temperature (up to 1900° F) and exposure (up to 1000 hours) at temperature on the tensile, compressive, bearing and shear properties were determined from measured stress-strain information in both the elastic and plastic range. The following five materials were considered in the program: (1.) 301 extra hard stainless steel, (2.) Ph15-Mo (TH 1050), (3.) AM 355, (4.) Rene 41, (5.) N-155. All material was from 0.050-inch sheet, except the material for the 1/8-inch-diameter shear pins, which

were fabricated from 1/4-inch plate. Heat treatment was in accordance with existing specifications for the materials, or other procedures approved by ASD to develop the optimum strength properties. Author

N63-15436 Aeon Labs., Egham (Gt. Brit.)
METALLOGRAPHY OF DISPERSION HARDENED ALLOYS AND ITS RELATION TO CREEP RESISTANCE Administrative Report No. 7, Oct. 15, 1962 to Jan. 14, 1963
J. A. Coiley Feb. 18, 1963 21 p 3 refs
(Contract AF 61(052)-463)

A study of the creep in SAP 930, in both the as-received (small grain) and heat-treated (large grain) form, is in progress. Special methods for preparing thin foils from the creep specimens are described. Some of the smaller particles, characteristic of the dispersed phase have been identified as γ-Al_2O_3. The strain field contrast, associated with the dispersed phase under certain orientation conditions, has been investigated in SAP 930. As a result of examination after heat treatment at lower temperatures (500° to 600° C), it is concluded that recrystallization or grain growth does not occur below approximately 630° C. Deformation experiments on heat-treated SAP 930 have shown that at 35% deformation the dislocations have "walled up" to produce a cell structure, while at >100% deformation a small grain size (~0.5μ) is formed. Author

N63-15456 Watertown Arsenal Labs., Mass.
ORIENTED SINGLE CRYSTALS OF ALUMINUM FOR X-RAY ANALYSIS
Joseph M. Dhosi, Charles P. Gazzara, and Raymond M. Middleton June 1962 11 p 4 refs
(WAA-TR-129.1/1)

A simple gradient-heating apparatus was developed and used successfully in growing oriented single crystals of high-purity aluminum suitable for X-ray diffraction analysis. Author

N63-15459 Watertown Arsenal Labs., Mass.
MASS EFFECT ON TENSILE PROPERTIES OF HIGH STRENGTH STEEL CASTINGS
Paul J. Ahearn Sept. 1962 18 p 8 refs
(WAL-TR-320.1/9)

The effect of mass on the tensile properties of high-strength (about 240,000 psi tensile strength) steel was determined by tests on specimens removed from a 6-inch-square and an 8-inch-diameter cast coupon. The steel employed was a modified 4330 steel with low sulfur and phosphorus contents. In addition to true stress-true strain tensile tests, metallographic and microradiographic studies were conducted to investigate the cause of this mass effect. All significant tensile properties were reduced by increasing mass or decreasing solidification rate; area and true-fracture strain were reduced to the greatest extent and the engineering tensile strength was reduced the least amount. The best properties were obtained in the columnar grain zone near the outside of the coupons. Mass effect appeared to be caused by the increased amount and greater intensity of the alloy segregation and larger dendritic arm spacing towards the center of the casting. The results indicated that nonmetallic inclusions and microshrinkage did not produce this loss in properties with increasing mass in these steel castings. Author

N63-15463 Republic Aviation Corp., Farmingdale, N.Y.
MECHANICAL PROPERTIES OF NICKEL AND COBALT BASE ALLOYS FOR INCLUSION IN MILITARY HANDBOOK-5 Research Investigation, Dec. 8, 1962 through Mar. 8, 1963
Aubrey Greene Mar. 11, 1963 71 p
(Contract AF 33(657)-8924)
(ESRD-13-10; RAC-1256)

This report summarizes initial mechanical-property-test data obtained for L-605 alloy material for tension, compression, bearing, shear, stress-rupture, creep, and fatigue at room and elevated temperatures, and for longitudinal and transverse directions. With the exception of compression and shear testing of sheet material, no other testing difficulties have been encountered. Author

N63-15465 Massachusetts Inst. of Tech., Cambridge
INVESTIGATION OF MECHANICS OF REINFORCED PLASTICS Technical Documentary Report [Oct. 1, 1959-Sept. 30, 1960]
Lawrence J. Broutman, William H. Haslett, Edward M. Krokosky, John R. Roy, and Frederick J. Mc Garry Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1962 254 p 46 refs
(Contract AF 33(616)-6280)
(WADD-TR-60-746, Pt. II)

Four aspects of the mechanics of reinforcement have been studied: (1) shrinkage stresses in thermosetting resin-fibrous glass systems containing relatively few glass elements; (2) improvement of a method for directly testing the strength of the resin-glass fiber joints; (3) a detailed investigation of flexural failure mechanisms in fabric-based laminate; and (4) particular solutions for aeolotropic plate behavior derived from the more general theory previously developed. The significant findings show that: (1) high axial stresses can be created in fibers, depending upon their length, diameter, surface condition, and relative orientation; (2) polyester-glass-fiber joint strengths reach a maximum value, contingent upon cure exotherm, while stronger epoxy-glass fiber specimens usually fail before interfacial fractures occur; (3) some of the modes of flexural fracture and the test method–material-strength interactions which apparently occur remain obscure though good progress was made; and (4) interlaminar stress and strain effects in plate specimens, thought to be operative from common qualitative experimental observations, are substantiated by theoretical analysis. Author

N63-15468 Watertown Arsenal Labs., Mass.
MECHANICAL PROPERTIES OF TITANIUM AND ALUMINUM ALLOYS AT CRYOGENIC TEMPERATURES
Charles F. Hickey, Jr. Mar. 1962 41 p 7 refs
(WAL-TR-340.2/1) OTS: $1.00

Low-temperature mechanical properties of titanium and aluminum alloys in both bar and sheet form were obtained as a function of testing temperature. For bar material, tensile and Charpy impact data were obtained at temperatures ranging from room temperature to −452° F for the tensile tests, and from room temperature to −441° F for the Charpy tests. For the material in the sheet form, notched-tension sheet and unnotched-tension sheet data were obtained at temperatures between room temperature and −320° F. A unique aspect of this work is the fact that materials which were investigated in both the bar and sheet form were from the same heat. The results of this investigation indicate that a majority of the titanium and nearly all the aluminum alloys are acceptable for applications in a cryogenic environment. Author

N63-15479 Lockheed Missiles and Space Co., Sunnyvale, Calif.
COLD WELDING IN A VACUUM: AN ANNOTATED BIBLIOGRAPHY
Scott J. Buginas, comp. Mar. 1963 24 p 44 refs
(SB-63-5)

This bibliography includes references issued primarily during the years 1959–1962. References are in alphabetical order by author's name. Author

N63-15494 Armour Research Foundation, Chicago, Ill.
RESEARCH ON THE BASIC NATURE OF STRESS CORROSION FOR VARIOUS STRUCTURAL ALLOYS AT ROOM AND ELEVATED TEMPERATURE Final Report [Oct. 15, 1960-Dec. 14, 1961]

Frank A. Crossley Wright-Patterson AFB, Ohio. Directorate of Materials and Processes, May 1962 70 p 6 refs
(Contract AF 33(616)-7612)
(ASD-TR-61-713)

The relationship between quantity of ASTM sea salt, varying from 0.0002 to 0.02 g/sq in., and thickness of anodized film—0, 2, and 8 microinches—in elevated temperature stress-corrosion cracking of the titanium alloys Ti-6Al-4V and B-120VCA was investigated. Exposure conditions were 800° F-25,000 psi-190 hr for the former alloy and 600° F-100,000 psi-190 hr for the latter. Damage was progressively greater with increasing quantity of salt. The anodized films appeared to be of no benefit to the Ti-6Al-4V alloy; however, it appeared that limited protection was afforded B-120VCA. The alloys: 2024-T86, 7075-T6, ZK-60A-T5, 17-7 PH RH 950, and B-120VCA in two conditions of grain size and two conditions of surface treatment were tested as follows: tensile test in air at room temperature, and in distilled water and ASTM sea water at 32°, 75°, and 212° F; and statically loaded at 90% of the yield strength in media of air, water, and ASTM sea water at room temperature. Other evaluations made were as follows: effect of surface contamination on the susceptibility of B-120VCA to premature failure in ASTM sea water; effect of ion species on the susceptibility of ZK-60A, 17-7 PH, and B-120VCA to stress corrosion or premature failure in static load tests; and behavior of weldments of B-120VCA in tensile and static load testing in ASTM sea water. The results indicate that B-120VCA is more resistant to failure than 17-7 PH under the conditions of these experiments. However, weldments of B-120VCA failed in the elastic region when tensile tested in ASTM sea water. Author

N63-15512 Bureau of Mines, Washington, D.C.
HIGH-TEMPERATURE CORROSION STUDIES. NICKEL AND COBALT IN AIR AND OXYGEN
Robert M. Doerr 1963 24 p 23 refs
(BM-RI-6231)

Isothermal oxidation kinetics were determined for three grades of Ni and for 99.99 percent Co in O_2 and in air from 800° to 1,200° C. The oxidation reactions followed approximately the parabolic rate law. For 99.99 percent Ni in O_2 at 1,200° C, the parabolic rate constant was 2 mg cm^{-2} $hr^{-1/2}$. For 99.99 percent Co in dry air, the constant ranged from 1 mg cm^{-2} $hr^{-1/2}$ at 800° C to 18 mg cm^{-2} $hr^{-1/2}$ at 1,200° C; for 99.99 percent Co in O_2 the constant was 2 mg cm^{-2} $hr^{-1/2}$ at 800° C and 10 mg cm^{-2} $hr^{-1/2}$ at 1,000° C. For 99 percent Ni in dry air, the constant ranged from 0.2 mg cm^{-2} $hr^{-1/2}$ at 800° C to 3 mg cm^{-2} $hr^{-1/2}$ at 1,200° C. By X-ray diffraction measurements, only divalent oxides were found in the scales. Author

N63-15515 Standard Pressed Steel Co. Research and Development Div., Jenkintown, Pa.
EVALUATION OF 200,000 PSI TITANIUM BOLTS AND LOCKNUTS. HI TI 20 SERIES–FN T20 SERIES. A TITANIUM FASTENER SYSTEM Laboratory Report
Edward F. Gowen, Jr. and Richard A. Walker Mar. 22, 1963 65 p
(SPS-730)

This report introduces a titanium fastener system with 200,000-psi minimum tensile strength. This system consists of Hi Ti 20 Series titanium bolts and FN T20 Series featherweight titanium locknuts. The tension fastener system has 200,000-psi base material and fastener tensile strength, resulting in tensile stress-to-density ratio of more than 1,240,000. This system is the strongest fastener assembly per unit weight available on the market today. The fatigue life at 100,000-psi maximum stress exceeds 65,000 cycles average. The shear fastener systems have a tensile strength of 140,000 psi and a fatigue life of 65,000 cycles average at a maximum stress of 70,000 psi. The Hi Ti 20 Series, tension and shear bolts, have a minimum shear strength of 120,000 psi, which is an increase of 25,000 psi over the requirements of NAS 621. Author

N63-15517 Union Carbide Nuclear Co., Oak Ridge, Tenn.
THE DESIGN AND PERFORMANCE OF LEVITATION MELTING COILS
W. J. Hulsey (M.S. Thesis–Tenn. U.) Apr. 26, 1963 69 p 15 refs
(Contract W-7405-eng-26)
(Y-1413) OTS: $1.75

Insufficient design information has limited the usefulness of the levitation melting process. This study was undertaken to evaluate the parameters involved in the performance of levitation coils with particular emphasis on the heating effect. The field strength along the axes of various coils was measured using a small search coil, the voltage induced on this search coil being proportional to the field strength. The search coil was calibrated with a straight solenoid coil in which the field strength was calculated. By considering each turn of a levitation coil as a short solenoid whose length was the tubing diameter, the field strength contribution from each turn was calculated. These values were summed along the axis to calculate the coil field. To aid these calculations, tables of field strength as a function of axial distance were prepared for various radii turns of different sizes of tubing. The contribution from a given turn to the total coil gradient was calculated as a function of its location. This data was graphed with axial distance as abscissa and turn radius as ordinate showing positions which give the same values of gradient contribution. The positions which contribute most to the coil gradient could be used to design coils of high gradient and, consequently, good heating efficiency. Author

N63-15534 Aeon Labs., Egham (Gt. Brit.)
METALLOGRAPHY OF DISPERSION HARDENED ALLOYS AND ITS RELATION TO CREEP RESISTANCE Annual Summary Report No. 15, Oct. 1960 to 14 Oct. 1961
J. A. Coiley Mar. 19, 1962 12 p 5 refs
(Contract AF 61(052)-463)

A variety of techniques have been investigated for preparing thin films of S.A.P. from bulk specimens for subsequent examination in the electron microscope. The three main categories of techniques are as follows: (a) electropolishing of thin sheet, (b) jet machining of 750-μ thick discs sliced from bars, followed by electropolishing, and (c) microtome sectioning. Thin films prepared by microtome methods have been shown to be useful for checking the distribution of alumina particles and the general microstructure of S.A.P., but are inadequate for any studies of dislocations. The normal jet machining methods are completely inadequate for S.A.P. due to pitting attack during machining; the pits lead to premature perforation during subsequent polishing treatments. The most successful technique has been to use a stationary jet technique followed by electropolishing in a special unit. The specimens used for this method are in the form of 500-μ thick discs which are cut from 3-mm diameter bar. Author

N63-15540 Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho
THE EFFECT OF RADIATION AND NITRIC ACID-NITRATE SALT SOLUTION ON SOME NON-METALLIC MATERIALS
L. A. Decker AEC National Reactor Testing Station, Dec. 10, 1962 36 p 15 refs
(Contract AT(10-1)-205)
(IDO-14598) OTS: $0.75

Several plastic materials and one ceramic alumina have been tested for possible use as electrical insulators and spacers in an electrolytic dissolver for processing irradiated nuclear fuels. Values were obtained for the impact strength, compressive strength, and electrical resistivity of the more resistant materials. Those which gave the most favorable performance were: Kynar (polyvinylidene fluoride—Pennsalt Chemicals Corporation) up to 1×10^8R total dose, Marlex (high density polyethylene—Phillips Petroleum Company) up to 2×10^9R total dose, G-7 glass fabric-silicone resin laminate (Taylor Corporation) up to 10^{10}R total dose, and ceramic alumina (AP 35—McDanel Refractory Porcelain Company) to

greater than 10^{10}R total dose. If a limited service life is taken into consideration in the design of the equipment, any one of the four materials should prove acceptable for use as spacers and insulators in an electrolytic-dissolver vessel. Author

N63-15545 Mississippi State U., State College
NONDESTRUCTIVE ANALYSIS OF THE BRITTLE FRACTURE BEHAVIOR OF CERAMIC MATERIALS [Final Report, Sept. 1, 1961-Aug. 31, 1962]
Gary G. Paulson, Julian H. Lauchner, Charley Scott, and George E. Weeks. Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Nov. 1962. 69 p. 11 refs
(Contract AF 33(616)-7347)
(ASD-TR-61-436, Pt. II)

The work effort under this project was divided into three areas. The first was devoted to an experimental analysis of the possibility of applying certain physical principles toward development of a nondestructive test for brittle materials. In this work, a technique called "diffusion doping" was studied as a possible tool to aid in analyzing brittle fracture. In Part Two, the work was of a theoretical nature. A one-dimensional heat-conduction problem was solved by the LaPlace transformation method. The problem consisted of a symmetrical composite body of five slabs that was moved suddenly from one temperature environment at equilibrium to a second temperature environment. Constant thermal properties and constant surface coefficients were utilized, and equations that express the temperature as a function of time and position were presented. In Part Three, relations were derived for thermal stresses set up under the conditions described in Part Two. No numerical answers were given, but the general systems of derived equations were utilized in indicating how the desired solutions could be obtained by digital-computer techniques. Author

N63-15549 Denver Research Inst., Colo.
A FUNDAMENTAL INVESTIGATION OF THE ALLOYING BEHAVIOR OF THE RARE EARTHS AND RELATED METALS [Final Report, Nov. 1, 1959-Oct. 31, 1962]
J. F. Nachman, C. E. Lundin, and A. S. Yamamoto. Wright-Patterson AFB, Ohio, Aeron. Res. Labs., Jan. 1963. 77 p. 19 refs
(Contract AF 33(616)-6787)
(ARL-63-15)

The vapor pressures of praseodymium, neodymium, and samarium have been measured with a Knudsen effusion apparatus. Also, using the same apparatus, thermodynamic activities of the liquid phase of the praseodymium–neodymium system have been determined. Heats of vaporization were established from the vapor-pressure data for praseodymium, neodymium, and samarium. The phase diagram for the praseodymium–neodymium system was determined from thermal analyses, metallographic examinations, and X-ray diffraction studies. Results of the thermodynamic activity studies and measurements of solid (room-temperature) and liquid densities indicate ideal behavior in both liquid and solid solutions, within the experimental error. Ideal behavior was predicted for the praseodymium–neodymium system, as there are essentially no differences between the component elements in considering such variables as electronic structure, crystal structure, atomic diameter, valency effect, electronegativity, and electron concentration. Author

N63-15552 Hanford Atomic Products Operation, Richland, Wash.
HEAT TREATMENT, TENSILE PROPERTIES, AND CORROSION RESISTANCE OF Zr-2a/o Nb-2a/o Sn ALLOY
J. J. Holmes. Apr. 25, 1963. 23 p. 8 refs
(Contract AT(45-1)-1350)
(HW-71023) OTS: $0.50

Some mechanical properties of zirconium base alloy (Zr-2a/o Nb-2a/o Sn alloy) are investigated so as to determine the use of this alloy in water cooled nuclear reactor systems as a high-strength cladding material. It is found that the heat treatability, strength, ductility, and other tensile properties of the Zr-2a/o Nb-2a/o Sn alloy make it acceptable for use as cladding material, but the corrosion resistance is so poor as to eliminate its candidacy. D.E.R.

N63-15556 Du Pont de Nemours (E.I.) and Co. Savannah River Lab., Aiken, S.C.
THE DIFFUSION OF LITHIUM IN ALUMINUM
Louis P. Costas. Feb. 1963. 9 p. 3 refs
(Contract AT(07-2)-1)
(DP-813) OTS: $0.50

The diffusion of lithium in aluminum was measured at various temperatures with diffusion couples of aluminum-LiAl. The activation energy, E, is 33.3 kcal/mol, and the diffusion factor, D_o, is 4.5 cm^2/sec. Author

N63-15566 National Bureau of Standards, Washington, D.C.
TRANSMISSION AND REFLECTION OF ELECTRONS BY ALUMINUM FOILS
Martin J. Berger. Apr. 1, 1963. 15 p. 3 refs
(NASA Contract R-80)
(NBS-TN-187) OTS: $1.60 ph, $0.80 mf

Electron transmission and reflection coefficients for aluminum foils, pertaining both to number and energy, are given for source energies between 0.125 and 2.0 mev, source obliquities ranging from perpendicular to grazing incidence, and foil thicknesses up to one-half of the electron mean range. The results were obtained by a Monte Carlo calculation. Author

N63-15625 Watertown Arsenal Labs., Mass.
FRACTURE SURFACE CONFIGURATIONS OF AISI 4340 STEEL AS AFFECTED BY TEMPERATURE AND GEOMETRY
Frank L. Carr and Frank R. Larson. Jan. 1963. 31 p. 11 refs
(WAL-TR-320.1/10)

Measurements of the different zones of fracture configurations were made on both smooth and notched tensile specimens in addition to Charpy specimens of AISI 4340 steel heat treated to three strength levels and tested over a range of temperatures (−196° to +200° C). These measurements plotted as a function of temperature result in transition curves due to the different modes of fracturing. The differences in both the locus of the origin and direction of propagation of fracture between the smooth and notched tensile specimens are discussed and illustrated. Similarities in the fracture configurations of both tensile and Charpy specimens are also described and illustrated. The importance of these fracture zones and their influence on the notch-strength ratio are discussed. Author

N63-15645 Bureau of Mines. Albany Metallurgy Research Center, Ore.
BENEFICIATION OF ALUMINUM PLANT RESIDUES
R. S. Mc Clain and G. V. Sullivan. 1963. 21 p.
(BM-RI-6219)

Continuous-circuit flotation and batch-scale precipitation tests were made by the Bureau of Mines to determine rejection of carbon and recovery of fluorine and aluminum compounds from aluminum-reduction-plant residues. About 40 to 60 pounds each of aluminum fluroide and cryolite are lost for each ton of aluminum produced. Gasoline and turpentine were satisfactory for floating carbon from both fresh-water and saturated-solution systems. Soluble fluorine and aluminum compounds were recovered by precipitation with sodium aluminate and carbon dioxide. Over 99 percent of the carbon was removed by flotation. Fluorine and aluminum recoveries up to 77 and 63 percent, respectively, were obtained in a combined precipitate and nonfloat product. In the fresh-water

system, the combined product was mostly cryolite with some gibbsite. In the saturated-solution system, the product was mostly sodium fluoride, some cryolite, and minor amounts of gibbsite. Author

N63-15650 Avco Corp. Lycoming Div., Stratford, Conn.

METASTABLE AUSTENITIC FORMING OF HIGH STRENGTH PRESSURE VESSELS First Semiannual Interim Technical Progress Report

A. J. Alexander Sept. 14, 1962 56 p 21 refs
(Contract AF 33(657)-7955)

A literature review was completed. Three alloys, Type H-11 hot work steel, AM 355 semiaustenitic stainless steel, and 18 NiCoMo (300) mar-aging steel were selected for shear-spinning evaluation. The selected materials were purchased and extruded, and shear-spinning preform blanks were machined. Subscale pressure cylinders with 0-, 25-, 50-, and 75-percent reductions were produced and final machining of test specimens started. One pressure vessel has been tested to failure. The available results of shear-spinning and biaxial-burst testing are presented. Author

N63-15689 Batelle Memorial Inst., Columbus, Ohio

FURTHER INVESTIGATION OF NOTCH SENSITIVITY OF REFRACTORY METALS Final Report [Oct. 1, 1961-Aug. 31, 1962]

Robert T. Ault Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Dec. 1962 140 p 32 refs
(Contract AF 33(616)-7604)
(ASD-TDR-62-1004)

Molybdenum and Mo-0.5Ti alloy with various degrees of cold work and different recrystallized grain sizes were tested to determine their low-temperature properties. Sufficient cold work (>25 percent; about 68 percent is sufficient) markedly reduced the ductile-to-brittle transition temperature of both materials, whereas increasing the recrystallized grain size increased this parameter. Mechanical notches resulted in pronounced degradation of properties in fibered structures, but were much less detrimental to recrystallized structure. This behavior was attributed to the controlling (detrimental) effect of grain boundaries in the fracture of recrystallized molybdenum or Mo-0.5Ti, regardless of material geometry. Author

N63-15710 Automation Industries, Inc. Ultrasonics Div., Torrance, Calif.

DEVELOPMENT OF ULTRASONIC TECHNIQUES FOR DEFECT EVALUATION [Final Report, Dec. 1959-Oct. 1961]

J. B. Ramsey and W. M. Rowe Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Feb. 1963 150 p 14 refs
(Contract AF 33(616)-6793)
(ASD-TDR-62-8)

The results of investigations to determine the effects of several metallurgical and acoustical variables on the ultrasonic signal strength, using commercially available ultrasonic flaw-detection equipment, are reported. Applied to various metals used in aerospace structures and components, these investigations resulted in the separation and determination of important acoustical properties that were expected to indicate the cause for differences in the transmission of ultrasonic energy in the various materials. A method was developed for applying correction factors to test blocks of one metal in order to estimate the size of defects in other metals. Beam collimation techniques were studied to determine optimum conditions for detecting defects and displaying them on both cathode-ray image and C-Scan (plan view) facsimile paper recordings. Some investigations were also performed to separate and identify shear and surface (Rayleigh) waves. Author

N63-15715 Materials Research Corp., Orangeburg, N. Y.

THE MECHANICAL PROPERTIES OF TANTALUM WITH SPECIAL REFERENCE TO THE DUCTILE-BRITTLE TRANSITION [Final Report, Apr. 1, 1961 to Apr. 1, 1962]

G. T. Murray and R. A. Burn Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1963 54 p 14 refs
(Contract AF 33(616)-7173)
(ASD-TR-61-203, Pt. II)

The lower yield stress-grain size relationship was studied in tantalum for two compositions; one consisting of a total interstitial content of 72 ppm with the major constituent being oxygen, and the other containing primarily carbon (116 ppm), in which part of the carbon existed in the form of a finely dispersed carbide precipitate. These results were compared to those obtained on commercial tantalum containing a total interstitial content of about 200 ppm. The parameters δ_i and K_y in the Petch equation

$$\delta y = \delta i + k_y d^{-1/2}$$

were of primary interest. The commercial tantalum exhibited significantly higher yield and flow stresses and correspondingly higher δ_i values. The carbon-containing material showed the lowest yield stresses, primarily because of its lower oxygen content. It was concluded that oxygen is much more effective than carbon in restricting dislocation movement. The effect of the carbide precipitate was to increase the work-hardening rate. The flow stresses, however, even in the presence of the carbide phase, were lower than those observed for commercial tantalum. Author

N63-15721 Hanford Atomic Products Operation, Richland, Wash.

RECOVERY AND RECRYSTALLIZATION OF ZIRCONIUM AND ITS ALLOYS. PART 3: ANNEALING EFFECTS IN ZIRCALOY-2 AND ZIRCALOY-3

S. H. Bush and R. S. Kemper Apr. 24, 1963 62 p 7 refs
(Contract AT(45-1)-1350)
(HW-69680)

Reactor-grade Zircaloy-2 and vacuum-melted Zircaloy-3V were prepared by arc melting twice under vacuum. In addition, argon-melted Zircaloy-3A was prepared by arc melting in a vacuum and then under argon. These materials were rolled into plate. Recovery, recrystallization, and grain growth as a function of cold-work level, composition, annealing time, temperature, and atmosphere were studied by hardness and electrical-resistivity measurements, and by metallographic observations. Recovery and secondary hardening were observed at temperatures of 300° to 500° C. Recrystallization began at 500° C and was essentially complete at 600° C after 1000 minutes or less. Recrystallization occurred by subgrain growth in material cold worked 10 percent. Conventional nucleation and growth occurred at 25 and 50 percent cold work. Definite differences in response to annealing atmosphere were observed. Vacuum annealed alloys recrystallized more slowly than air- or helium-annealed alloys. Author

N63-15723 Rolla Metallurgy Research Center, Bureau of Mines, Mo.

RECLAIMING S-816 HIGH-TEMPERATURE ALLOY SCRAP

Leo W. Higley, Jr. 1963 16 p 8 refs
(BM-RI-6230)

Procedures were developed for reclaiming high-temperature alloy scrap in the form of standard cobalt-base alloy. A cobalt-base, multicomponent, high-temperature alloy, such as S-816, can be successfully melted from scrap, and its specified chemical composition can be retained. Induction furnace melting in a controlled atmosphere was used to obtain ingots that were subsequently fabricated by impact forging to provide specimens for heat treatment and testing. Of the numerous metal elements in S-816 alloy, only small quantities of molybdenum were lost in the melting operation as finally developed. Test results indicated that the scrap material, after melting, forging, and heat treatment, was equivalent

in room-temperature tensile strength, in high-temperature creep and stress-rupture properties, and in chemical composition to commercially produced S-816 alloy made from virgin material. Author

N63-15726 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

PRIMITIVE LEAD FROM IRON METEORITES

Royal R. Marshall and Jürg Feitknecht Feb. 4, 1963 20 p 21 refs
(NAS Contract NAS7-100)
(JPL-TR-32-371) OTS: $1.60 ph, $0.80 mf

Isotopic analyses show that the Odessa iron meteorite, as well as the Toluca iron meteorite, contains the primeval lead which Patterson, Brown, Tilton, and Inghram first discovered in the troilite obtained from the Canyon Diablo and Henbury iron meteorites. However, significant variations of isotopic ratios occur within all these meteorites. Lead from samples of the Odessa meteorite has unusually large amounts of Pb^{206} which increase with the bismuth content. Nuclear synthesis may account for the differences in isotopic composition found in different samples of this meteorite. There is no suggestion of transitions towards the radiogenic type of lead observed in some iron meteorites (including Toluca). Within the limits of error, the sample of the Piñon nickel-rich ataxite contained no detectable lead. This result corroborates independent measurements which indicate that this type of iron meteorite contains, at the most, only a few hundredths' ppm of lead. Octahedrites, on the other hand, may contain as much as 0.25 ppm of lead. Author

N63-15730 Bureau of Mines. Albany Metallurgy Research Center, Ore.

QUARTERLY METALLURGICAL PROGRESS REPORT NUMBER 18, FOR THE PERIOD OF JANUARY 1, 1963 TO MARCH 31, 1963

A. H. Robertson 1963 32 p
(Contract AT(11-1)-599)
(USBM-U-1031) OTS: $0.75

Phase relationship diagrams of rare-earth alloys and hafnium alloys are given. The melting temperature and hardness of thorium alloys were investigated. Pressed and sintered powder compacts of refractory high-temperature alloys were fabricated for determining physical, mechanical, and chemical properties. Solid-state diffusion bonding, thermodynamics of the cold mold, electron beam melting, and hafnium carbide casting are considered. N.E.A.

N63-15731 Case Inst. of Tech., Cleveland, Ohio

AN INVESTIGATION OF TRANSFORMATION CHARACTERISTICS OF THREE URANIUM BASE ALLOYS Final Report [Jan. 1-Dec. 31, 1962]

P. E. Repas, R. H. Goodenow, and R. F. Hehemann Jan. 1963 76 p 31 refs
(Contract DA-33-019-ORD-3630)
(Tech. Rept. AMRA-CR-63-02/1(F))

TTT diagrams are presented and transformation kinetics are described for five alloys: (1) U-10%Mo, (2) U-8%Mo, (3) U-8%Mo-1/2%Ti, (4) U-8%Mo-1%Ti, and (5) U-2%Mo-2%Nb-2%Zr-1/2%Ti. Metallographic, dilatometric, hardness, and X-ray techniques were utilized in establishing the TTT diagrams. Sensitivity and limitations of each technique are discussed. Metallographic techniques have been perfected for the uranium-base alloys for nearly all conditions of heat treatment. Certain low-temperature transformation structures and the identification of nonmetallic inclusions have not been completely resolved. Metallographic structures of the specimens submitted by U.S. Army Materials Research Agency are interpreted, where possible, in terms of the established TTT diagrams.
Author

N63-15732 Aeronautical Research Labs., Melbourne (Australia)

THE INFLUENCE OF SMALL ADDITIONS OF SILVER ON THE AGEING OF ALUMINIUM ALLOYS: STUDIES OF AL-CU, AL-MG, AND AL-CU-MG ALLOYS

I. J. Polmear June 1962 30 p 28 refs
(ARL/MET-45)

Earlier work revealed that small amounts of silver (~0.1 at. %) may exert a marked effect on structure and aging characteristics of certain alloys based on the Al-Zn-Mg system. Silver additions have now been made to other age-hardening aluminum alloys, and significant effects have been observed in Al-5% Mg and in several high-purity and commercial purity Al-Cu-Mg alloys. Several similarities exist between the behavior of alloys from all three systems, notably that in each case silver stimulates nucleation of a partly coherent, intermediate precipitate which forms when the alloys are aged in the medium temperature range (~120° to 220° C.). The mechanism for this effect is uncertain although it is suggested it may originate in a preferred affinity between magnesium and silver atoms. There is evidence which indicates that the effects of silver are unique to that element. Contrary to the result for Al-Zn-Mg alloys, silver did not promote an even dispersion of precipitate in grain-boundary regions of Al-5% Mg or the Al-Cu-Mg alloys. Author

N63-15749 Hammond Metallurgical Lab., Yale U., New Haven, Conn.

X-RAY DIFFRACTION STUDY OF DEFORMATION BY FILING IN BCC REFRACTORY METALS Technical Report No. 4

E. N. Aqua and C. N. J. Wagner Mar. 1963 50 p 33 refs
(Contract NONR-609(43))

The bcc refractory metals, niobium, tantalum, vanadium, chromium and tungsten, were cold worked by filing at room temperature. The broadening of the powder pattern peaks was studied by Fourier analyses of the line shapes. The effective particle sizes and root mean squared strains were measured in different crystallographic directions. Anisotropic values of particle sizes observed in tantalum and niobium were an indication of faulting in these metals. The degree of anisotropy of particle sizes was much smaller in vanadium; tungsten and chromium showed isotropic particle sizes. Author

N63-15750 Nuclear Metals, Inc., Concord, Mass.

SOLUBILITY AND DIFFUSION OF GASES IN BERYLLIUM [Final Report, Nov. 1960-Oct. 1961]

J. P. Pemsler, R. W. Anderson, and E. J. Rapperport Wright-Patterson AFB, Ohio, Dir. of Materials and Processes, Feb. 1963 32 p 8 refs
(Contract AF 33(616)-7665)
(ASD-TDR-62-1018)

Results of an experimental program to determine the solubility and diffusion rate of nitrogen, hydrogen, and oxygen in beryllium are reported. The solubility of nitrogen in beryllium at 1000° C is estimated to be about 60 ppm; this value appears to be temperature independent. The results of nitrogen diffusion experiments are considered tentative. The solubility of hydrogen in beryllium is believed to be very small. Measurement of the growth characteristics of hydrogen bubbles formed in beryllium by proton bombardment indicate a value for the diffusion coefficient of hydrogen in beryllium of 9×10^{-10} cm^2/sec at 850° C. Author

N63-15754 National Carbon Co., Parma, Ohio

RESEARCH STUDY TO DETERMINE THE PHASE EQUILIBRIUM RELATIONS OF SELECTED METAL CARBIDES AT HIGH TEMPERATURES

R. V. Sara, C. E. Lowell, and R. T. Dolloff Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Feb. 1963 50 p 23 refs
(Contract AF 33(657)-8025)
(WADD-TR-60-143, Pt. IV)

The work summarized in this report is the result of investigations of phase equilibria in the binary systems, zirconium-carbon, tantalum-carbon, and boron-carbon. A completed phase diagram, which encompasses experimental results and considerations heretofore unreported in the literature, is presented for the zirconium-carbon system. A tentative phase diagram for the tantalum-carbon system is included, which, in general, resembles the version released by Ellinger in 1943. Preliminary results for the boron-carbon system, depicting maximum solubility in the graphite lattice below the eutectic temperature of approximately 2390° C, are also included. Author

N63-15755 General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio

HIGH-TEMPERATURE MATERIALS PROGRAM Progress Report No. 21, Part A, Jan. 1, 1963 to Feb. 15, 1963

Apr. 23, 1963 31 p refs
(Contract AT(40-1)-2847)
(GEMP-21A) OTS: $0.75

High-temperature reactor materials fabrication and the effect of radiation on high-temperature alloys are reviewed. The stress-rupture testing of molybdenum in hydrogen and argon at 2200° C was extended from 10 hours to 100 hours. Data obtained are in excellent agreement with values obtained by linearly extrapolating the data from the 10-hour life tests. The creep rates determined from these lower-stress, longer-life tests are consistent with those determined from the higher-stress, shorter-life tests. The Larson-Miller constant was determined for molybdenum data at 2200° C and 2400° C. These data compared well with that of other investigators working at 870° C, 980° C, and 1100° C. Initial testing of control and irradiated molybdenum and tungsten specimens indicate measurable differences due to irradiation. Completed results on the effect of solution temperature on the 870° C stress-rupture properties of irradiated René-41 have confirmed that the lower 1065° C solution temperature is associated with greater irradiation damage. An evaluation of the effect of fast neutron dosage on the elongation values in 650° C stress-rupture tests showed differences between the three high-temperature alloys, A-286, Hastelloy X, and René-41. Unlike the stress-rupture results, all three alloys showed losses in ductility at 9×10^{14} nvt ($E_m \geq 1$ mev). A-286 alloy specimens showed that a saturation to damage was reached at about 10^{17} nvt. The saturation in ductility changes in Hastelloy X was not as prominent as noted for A-286. René-41 specimens yielded significant losses in ductility and appeared to show a saturation at approximately 10^{15} nvt. I.v.L.

N63-15756 General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio

HIGH-TEMPERATURE MATERIALS AND REACTOR COMPONENT DEVELOPMENT PROGRAMS. VOLUME I: MATERIALS Second Annual Report [1962]

Feb. 28, 1963 198 p refs
(Contract AT(40-1)-2847)
(GEMP-177A) OTS: $3.00

This report is one of three volumes of the second annual-progress report on GE-NMPO high-temperature materials program conducted during Calendar Year 1962. This volume covers four unclassified development programs: (1) materials for use as fuel and nonfuel high-temperature (1000° to 3000° C) reactor structural applications; (2) radiation effects in high-temperature alloys exposed to neutron environment at temperatures up to 870° C and dosages of 10^{19} nvt; (3) radiation effects in BeO as a function of composition, grain size, density, porosity, and irradiation temperature and dosage; (4) long-term irradiation test of 80Ni–20Cr fuel element specimen in air at 700° to 815° C. Author

19 MATERIALS, NON-METALLIC

Includes: mechanical and physical properties of non-metals (e.g., plastics).

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-15246 France. Ministère de l'Air, Paris

PERMÉABILITÉ DES MATIÈRES PLASTIQUES A LA VAPEUR D'EAU [PERMEABILITY OF PLASTIC SUBSTANCES TO WATER VAPOR]

Marie Korte Paris, Service de Documentation et d'Information Technique de l'Aeronautique (SDIT), [Feb.] 1963 85 p 82 refs In French
(*Its* Publications Scientifiques et Techniques, N.T.-124) Available from SDIT, 2, Ave. de la Porte d'Issy, Paris (15e)

Experiments to find the coefficient of permeability of various plastic materials to water vapor have been conducted. The purpose of such experiments was to determine the effect of water absorption on adhesive properties, on the cohesion of resins and other bonding materials at joints, and to find the effects of the chemical nature and physical texture of substances on water permeability properties. Results are presented in a numerical order. Rheological resistance by diffusion of gases is also discussed. Trans. by D.E.R.

N63-15266 Bettis Atomic Power Lab., Westinghouse Electric Corp., Pittsburgh, Pa.

THE THERMAL STABILITY OF TEFLON AND ITS COMPATIBILITY WITH AUSTENITIC STAINLESS STEEL AND OTHER STRUCTURAL MATERIALS

R. E. Moore *In its* Bettis Technical Review Reactor Technology Mar. 1963 p 53–60 3 refs (See N63-15261 12-10) OTS: $2.00

An investigation was made of Teflon in contact with austenitic stainless steels and with other structural materials. Teflon displayed excellent thermal stability in aerated water at 400° to 550° F and above, and no stress corrosion cracking of stressed samples was observed after 28 days in 535° F aerated, deionized water (pH 10). It is concluded that Teflon can be safely used under conditions up to 535° F in aerated or in nonaerated high-purity water. Teflon is compatible with structural alloys in aerated water even up to 636° F but is subject to cold flow at these conditions. Author

N63-15269 National Bureau of Standards, Washington, D.C.

PROPERTIES OF GLASSES AT ELEVATED TEMPERATURES [Interim Report, Jan.-Dec. 1961]

M. J. Kerper, T. G. Scuderi, and E. H. Elmer Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Apr. 1962 99 p 10 refs
(Contract AF 33(616)-59-4)
(WADC-TDR-56-645, Pt. VI)

In order to establish realistic design criteria applicable to selected oxide glasses having utility as viewing windows in Air Force vehicles, certain physical properties have been determined throughout the useful temperature range of the glasses. Data are presented on several glasses at the top temperature at which short-time modulus of rupture testing can be conducted. The stress rupture results for all seven glasses in the program are presented. Creep results obtained on Pittsburgh Plate Glass 6695 are also given. Equations have been developed to represent the relationship of the "mirror radius" on the fracture surface to the modulus of rupture data. An analysis of the distribution of strength values of glass was carried out. The data show essentially that glass does fit normal theory, with certain reservations. A description of the apparatus used for determining the relationship between strength and size, together with some preliminary findings regarding this relationship, is presented. Author

N63-15313 RIAS, Div. of Martin Co., Baltimore, Md.
THE SURFACE SENSITIVE MECHANICAL BEHAVIOR OF IONIC CRYSTALS Quarterly Status Report No. 4, 27 Dec. 1961-31 Mar. 1962
A. R. C. Westwood [1962] 37 p 44 refs
(Contract DA-36-034-505-ORD-3349RD)
(WAL-TR-832/1-5)

The surface sensitive mechanical behavior of ionic crystals can be broadly understood in terms of the effects of surface sources of dislocations, surface contaminants, and surface defects. These three factors, the extreme notch sensitivity of ionic crystals, and the results of some recent investigations performed mainly on NaCl, LiF, and MgO crystals are discussed in connection with Roscoe, Rebinder, and Joffé phenomena. Author

N63-15349 General Dynamics/Fort Worth. Nuclear Aerospace Research Facility, Tex.
INVESTIGATION OF COMBINED EFFECTS OF RADIATION AND VACUUM AND OF RADIATION AND CRYOGENIC TEMPERATURES ON ENGINEERING MATERIALS Third Quarterly Progress Report, 9 May 1962 through 31 July 1962
E. E. Kerlin and E. T. Smith Aug. 15, 1962 78 p 18 refs
(NASA Contract NAS8-2450)
(FZK-152) OTS: $7.60 ph, $2.54 mf

The combined effects of radiation and cryogenic temperatures on engineering materials were investigated. Work included the analysis and selection of materials for testing in the program, organization of test plan, completion of preliminary designs on all test equipment, and development of the nuclear dose measurements plan. Other work included the operational checkout of the vacuum-irradiation systems, checkout of the pre- and post-irradiation vacuum systems, completion of the materials selection, design of a bearing-lubricant test apparatus, fabrication of the weight-loss measuring apparatus, and development of the nuclear dose measurements plan. Author

N63-15362 Solar, San Diego, Calif
EXPLORATION AND EVALUATION OF NEW GLASSES IN FIBER FORM Final Report, 15 Nov. 1961 through 25 Nov. 1962
Gunther K. Schmitz and A. G. Metcalfe Apr. 12, 1963 87 p
(Contract Nonr 3654(00)(X))
(RDR-1266-7)

The length effect on fiber strength was studied for E-glass and 994 glass fibers. These fibers were primarily from strands. Tensile-test results confirmed the linear log strength–log length relationship previously established and that fiber strength increases with decreasing length. At short fiber lengths (below 0.5 cm), the strength–length curve showed a change in slope due to the presence of mixed flaw populations, which were indicated in bimodal failure distributions in the vicinity of the slope change. Some comparative tests on strand strength showed a strength reversal with decreasing test length. The reversal could be related to the effect of fiber collimation. Comparison of fiber properties of the different glasses on the basis of strength, weight, Young's modulus, surface damage, and fiber length showed that 994 fibers are superior to E-glass by a factor of approximately 1.7 for longer fibers. Author

N63-15372 Fenwal Inc., Ashland, Mass.
FIBER OPTICS IN AEROSPACE VEHICLE HAZARD DETECTION Final Report
Alan C. Traub Wright-Patterson AFB, Ohio, Directorate of Aeromechanics, Dec. 1962 225 p 151 refs
(Contract AF 33(616)-8165)
(ASD-TDR-62-731)

Light-transmitting glass-fiber bundles in various configurations have been subjected to extensive optical, mechanical, and thermal testing and to various other analyses. The report provides important information on fiber optic characteristics as well as design considerations for developing optimum systems. System configurations are recommended which would extend the capabilities of the basic fiber bundle in meeting the diverse requirements of installation, operation, and maintenance in various applications. An experimental fiber-optic system for flame detection is described. Author

N63-15401 Eidgenössische Technische Hochschule, Zurich (Switzerland)
EINE EXPERIMENTELLE UNTERSUCHUNG DES ZUSAMMENHANGES ZWISCHEN DEN MASSE- UND FESTIGKEITSSCHWANKUNGEN VON BAUMWOLLGARNEN [AN EXPERIMENTAL INVESTIGATION OF THE CONNECTION BETWEEN THE MASS- AND STRENGTH VARIATIONS OF COTTON YARNS]
Arthur Hasler (Ph. D. Thesis) 1962 106 p 17 refs In German (*Its* Prom. 3094)

The connection between mass variations and strength variations of cotton yarns is reviewed. Results are presented which provide adequate orientation as to the mutual stochastic dependency between mass, twist, and strength of test specimens of yarns of various lengths (cm). I.v.L.

N63-15408 Illinois U., Urbana
THE PHENOMENON OF FRACTURE AND THE FRACTURE MORPHOLOGY OF GLASS TESTED IN TENSION, FLEXURE AND TORSION
N. M. Cameron Apr. 1963 115 p 14 refs
(Contract Nonr-2947(02)(x))
(Tech. Memo-190; T&AM-242)

A method of testing glass rods in tension and torsion was devised. Two types of glass, Pyrex and Soda-lime, were tested in tension, flexure, and torsion, and the data were analyzed by both Normal and Weibull statistics. A significant difference in strength was found to exist between the tension and flexural techniques of testing of similar specimens of Soda-lime glass. This difference is explained by the size effect brought about by the pre-existing flaw concept. A significant difference was also found between similar specimens of Pyrex and Soda-lime when both were tested in tension. This is explained by a difference in intrinsic strengths of the two glasses. Explanations are put forward concerning the formation of certain fracture markings, and light and electron micrographs are presented to indicate the various markings that may be observed on glass-fracture surfaces. Author

N63-15422 Materials Research Corp., Orangeburg, N.Y.
THE ROLE OF THE GRAIN BOUNDARY IN THE DEFORMATION OF CERAMIC MATERIALS [Summary Report, Mar. 1961-Mar. 1962]
G. T. Murray, J. Silgailis, and A. J. Mountvala Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Dec. 1962 41 p 9 refs
(Contract AF 33(616-7961)
(ASD-TDR-62-225)

The grain boundaries of MgO bicrystal specimens were subjected to creep-rupture tests in the temperature range of 1300° to 1500° C and at shear stresses varying from 150 to 10,000 gm/mm^2. The boundary was oriented at 45° to the compression direction. The stress for grain-boundary sliding and fracture varied markedly with crystal misorientation; high twist-low tilt boundaries being much weaker than other misorientations. For a given misorientation, there was considerable scatter in the fracture and sliding stress data which was found to be a result of boundary irregularities (jog content) present in the as-received material or stress-induced during test. Most specimens did not exhibit controlled grain-boundary sliding, but would slide uncontrollably to fracture after an incubation period of a few minutes at a critical stress. Author

N63-15466 Atomic Energy Research Establishment, Harwell (Gt. Brit.)
THE PERMEABILITY OF SOME PLASTIC MATERIALS TO H_2, He, N_2, O_2, AND A
R. S. Barton Feb. 1960 10 p 3 refs
(AERE-M-599) HMSO: 1s 9d

The report consists of a table showing the permeability of a number of plastics to H_2, He, N_2, O_2 and A, and describes the apparatus and technique used to obtain the information. Author

N63-15481 Solar, San Diego, Calif.
EXPLORATION AND EVALUATION OF NEW GLASSES IN FIBER FORM Bi-Monthly Progress Report No. 1, Feb. 11, 1963-Apr. 15, 1963
Gunther K. Schmitz Apr. 17, 1963 17 p 1 refs
(Contract Nonr-3654(00)(X))
(RDR-1343-1)

Fiber-damage techniques have been developed during this reporting period. Significantly different damage characteristics were obtained during a series of preliminary tests as reflected by slope differences in strength–length diagrams. These techniques will serve as a basis for the future work in this program. Author

N63-15612 Watertown Arsenal, Mass.
DYNAMIC STRESS CONCENTRATION FACTORS
Richard Shea Mar. 1963 18 p 6 refs
(WAL-TR-811.6/1)

The problem of the response of structural discontinuities to short-duration stress pulses is studied experimentally. Employing explosively induced stress pulses in thin plastic plates containing central circular holes, a dynamic stress-concentration factor is determined as a function of pulse frequency. It is concluded for this loading case that the dynamic stress concentration is significantly lower than the static value. Author

N63-15644 Telecomputing Corp. Narmco Research and Development Div., San Diego, Calif.
DETERMINATION OF THE PERFORMANCE OF PLASTIC LAMINATES UNDER CRYOGENIC TEMPERATURES Quarterly Progress Report No. 4, Nov. 8, 1962-Feb. 1, 1963
Norman O. Brink Feb. 1963 19 p
(Contract AF 33(616)-8289)

This report includes the results of investigations upon the improvement of test-specimen configurations. The results of tensile and flexure tests performed upon two epoxy materials at room temperature, -320°, and -110° F are also included in this report. Author

N63-15655 Picatinny Arsenal. Plastics Technical Evaluation Center, Dover, N.J.
DEFENSE SPECIFICATIONS AND STANDARDS FOR AND RELATING TO REINFORCED PLASTICS
Norman E. Beach Mar. 1963 17 p
(PLASTEC NOTE-3) OTS: $0.50

This report presents the results of a search for Government specifications and standards which are for or related to reinforced plastics. The findings are listed in six tables, covering general specifications, materials, laminates, filled resins, sandwich construction and applications. The citations are current and complete. In addition to the number-date-title information, the reader can note whether there is a qualified products list issued for the specification, whether the specification is limited to one service or is broadly applicable, who prepared it, and who are its custodians. The tables are followed by an identification of the code used in citing the preparing activities and the custodians of the specifications, a numerical listing of the specifications cited, and a brief instruction on how to procure Government specifications. There are 149 specifications listed. Author

N63-15664 National Bureau of Standards, Washington, D.C.
PROPERTIES OF GLASSES AT ELEVATED TEMPERATURES [Interim Report Jan. 1956-Dec. 1961]
Matthew J. Kerper Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Aug. 1962 91 p 14 refs
(Contract AF 33(616)-59-4)
(WADC-TR-56-645, Pt. VII)

The ASD program to obtain useful, statistically sound, design criteria on optically transparent window materials of a brittle nature and suitable for military air-vehicle applications, is summarized. Several factors associated with the determination of Young's modulus and the modulus of rupture for seven commercially available glasses are presented and interpreted. The practical strength of plate glass is dependent on several factors, including surface finish, thermal conditioning, cutting techniques, and composition. Effects of these variables together with long- and short-time elevated-temperature-strength capabilities are shown. Author

20 MATHEMATICS

Includes: calculation methods and theory; computers; data processing; and numerical analysis.

For related information see: 08 Communications; 09 Electronics; 10 Facilities; and 22 Navigation and Guidance.

N63-15245 RAND Corp., Santa Monica, Calif.
DIFFERENTIAL-DIFFERENCE EQUATIONS
Richard Bellman and Kenneth L. Cooke Jan. 1963 475 p refs
(Contract AF 49(638)-700; Proj. RAND)
(R-374-PR) Available from RAND Corp.

The Laplace transform, linear differential equations, difference equations, series expansions, constant coefficients, renewal equations, exponential polynomials, and systems of differential–difference equations are covered in this report. D.E.R.

N63-15248 Rensselaer Polytechnic Inst., Troy, N. Y.
AN ADAPTIVE-PREDICTIVE MODEL FOR NONLINEAR PROCESSES WITH TWO-LEVEL INPUTS
Rob Roy, R. W. Miller, and P. M. De Russo [1962] 26 p 5 refs
(NASA Grant NsG-244-62)
OTS: $2.60 ph, $0.98 mf

The requirements and theory of an adaptive–predictive model for processes with two-level inputs is presented. Fifty to two hundred coefficients are utilized to reasonably model the process. By using seven bits of information for each coefficient, 1% accuracy in the coefficient value is obtained, and these, in conjunction with serial access, result in a practical digital-computer model. The usability, and performance of the model are studied to discover its applicability. D.E.R.

N63-15278 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
STUDIES IN THE ASYMPTOTIC THEORY OF CONTROL SYSTEMS; I. STOCHASTIC AND DETERMINISTIC N-STAGE PROCESSES
David S. Adorno May 27, 1960 20 p 4 refs
(NASA Contract NASw-6)
(JPL-TR-32-21) OTS: $1.60 ph, $0.80 mf

In this report, the asymptotic behavior of a particular class of control systems is studied, with particular emphasis being placed on the questions of convergence and the steady-state forms of the loss function and of the system itself. The concept of policy equivalence is introduced and used to show that a stochastic, linear, first-order control system with quadratic loss function is policy equivalent to the deterministic system which depends only on the

expected states of the system. With this theorem as justification, only deterministic systems are considered for the remainder of the report. However, some generalizations and extensions of this problem are introduced, with special reference to statistical implications in the adaptive control system. The particular class of control systems referred to above is the class of linear, first-order, matrix-difference equations with quadratic loss criterion. For an N-stage process in this class, the technique of dynamic programing is used to determine the optimal policy. From this technique, we obtain the forms of the loss function and the state vector under optimal control. Author

N63-15317 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
NUMERICAL MATRIX INVERSION WITH ITERATIVE IMPROVEMENT
Cleve Moler Mar. 15, 1963 15 p 6 refs
(NASA Contract NAS7-100)
(JPL-TR-32-394) OTS: $1.60 ph, $0.80 mf

The numerical solution of the matrix equation $Ax = b$ is discussed. An iterative correction method for improving the result obtained by Gaussian elimination is described, and the convergence of the method to the correctly rounded solution is proved under a hypothesis involving the condition of the matrix. Several related topics are considered and numerical examples given. Author

N63-15327 Sylvania Electronic Systems, Waltham, Mass.
TRANSFER FUNCTIONS IN MATHEMATICAL SIMULATION FOR RELIABILITY PREDICTION Final Report
Irving Bosinoff et al Jan. 30, 1963 192 p 27 refs
(Contract AF 30(602)-2376)
(RADC-TDR-63-87)

This report presents the results of the second phase of the study program for the development of techniques for predicting the reliability of electronic systems from statistical information about the performance of system components. The transfer functions which have been developed in this phase are mathematical models of the actual systems to be evaluated. They are used to determine system performance when component characteristics vary from nominal values. This report concludes that the simulation techniques used are the most efficient for the purpose and have distinct advantages. The circuits analyzed will not only serve as vehicles to substantiate the findings of the first contractual phase, but will, in addition, serve as a nucleus for a library of preferred designs with defined lifetime characteristics. Author

N63-15328 Pennsylvania U. Moore School of Electrical Engineering, Philadelphia
INVESTIGATION AND EVALUATION OF UDOFTT MATHEMATICAL PROCEDURES
Morris Rubinoff, Harry J. Gray, Jr., William C. Sleemer, and Alvin L. Vivatson Dec. 7, 1962 91 p 8 refs
(Contract N61339-838)
(NAVTRADEVCEN-838-2)

This was an investigation of the mathematical methods used in UDOFTT. The investigation has provided an evaluation, both from a theoretical and an experimental aspect, of the mathematical methods used in UDOFTT. These mathematical methods were the numerical methods that were used to solve the simultaneous system of nonlinear differential equations of flight for the F-100A. Author

N63-15340 Air Force Cambridge Research Labs. Electronics Research Directorate, Bedford, Mass.
BOOLEAN MATRICES AND THE STABILITY OF NEURAL NETS
R. H. Urbano Jan. 1962 25 p 2 refs
(AFCRL-62-31)

The functional states of a neural (combinatorial) net of prescribed interconnection geometry and overall net function are characterized and enumerated. The problem is formalized for nets having an arbitrary number of inputs and outputs by introducing the notion of a Boolean matrix. Various theorems, forming a basis for the treatment of other neural net problems, are proved. A discussion of the concept of stability leads to a definition of a measure of net stability closely related to the set of functional states over which the input–output function is invariant. Author

N63-15363 New York U. Coll. of Engineering, N. Y.
COMPUTER CONSTRUCTION AND EVALUATION OF LONG BURST-ERROR CORRECTING CODES Twelfth Scientific Report
J. J. Metzner Jan. 31, 1963 98 p 6 refs
(Contract AF 19(604)-6168)
(AFCRL-63-28)

This report presents a specific method of programing a digital computer to construct and evaluate codes suitable for use in a burst-error correction decoding scheme. Two (100, 50) codes of this type have been constructed using the methods described. One is found capable of correcting uniquely all bursts of length 21 or less. The method used to evaluate burst-error correcting capabilities is applicable to any group code. Memory limitations have restricted the present program to code lengths not exceeding 105 digits, of which at most 63 may be check digits. Author

N63-15364 Systems Development Corp., Santa Monica, Calif.
BOUNDED ALGOL-LIKE LANGUAGES Scientific Report No. 3
Edwin H. Spanier (California U.) and Seymour Ginsburg Feb. 11, 1963 72 p 11 refs
(Contract AF 19(628)-485)
(TM-738/002/00; AFCRL-63-89)

This report considers the bounded ALGOL-like languages and shows that certain questions about them are recursively solvable. Among results established are: (1) Bounded languages are decomposed into "simpler" ones characterized as the smallest family of languages closed with respect to three "elementary" operations. (2) A generalized sequential machine transforms a bounded language to a bounded language. (3) A decision procedure is given for determining of an arbitrary ALGOL-like language as to whether it is bounded or not. (4) It is solvable to determine of arbitrary ALGOL-like languages L_1 and L_2, one of them bounded, whether $L_1 \subseteq L_2$ and whether $L_2 \subseteq L_1$. (The same problems with the boundedness condition removed are recursively unsolvable.) Author

N63-15373 Bettis Atomic Power Lab., Westinghouse Electric Corp., Pittsburgh, Pa.
BETTIS FORTRAN PROGRAMMING: AUXILIARY SUBROUTINES [Interim Memorandum]
O. J. Marlowe Feb. 1963 86 p 4 refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-365) OTS: $2.00

Extensions to the FORTRAN language in the areas of storage allocation, including the use of auxiliary storage, input-data format and processing, and operating-system requirements are discussed. Detailed descriptions of the machine-language subroutines representing these extensions are given along with a general description of the subroutine packages and their use. Author

N63-15386 Stanford U. Applied Mathematics and Statistics Labs., Calif.
COUNTER MODELS AND APPLICATIONS TO DETECTION PROBLEMS
Hans Zweig Apr. 12, 1963 80 p 20 refs
(Contract Nonr-225(52))
(Tech. Rept. 87)

The quantum efficiency method of radiation detection is analyzed and used to evaluate several counter models. Included are: dead time counters, coincidence counters, combinations of these two, photographic counters, detector counters, and applications and methods of the various counters. D.E.R.

N63-15387 Stanford U. Applied Mathematics and Statistics Lab., Calif.
FOSTER'S MARKOV CHAIN THEOREMS IN CONTINUOUS TIME
Rupert G. Miller, Jr. Apr. 19, 1963 13 p 10 refs
(Contract Nonr-225(52))
(Tech. Rept. 88)

An analysis of the probability theory known as a simple continuous time Markov chain has been made for the purpose of extending the theorems for positive recurrent chains in discrete time to continuous time. Two theorems and the corresponding proofs are presented and a bibliography is included to refer to their application. D.E.R.

N63-15418 Illinois U. Engineering Experiment Station, Urbana
ON NONSTATIONARY WHITE NOISE Technical Report
Y. K. Lin Mar. 1963 14 p 4 refs
(AAE-63-1)

This paper introduces the concept of a nonstationary white noise, which may be viewed as Poisson-distributed impulses with varying impulse strength. The response of a linear system to the excitation of a nonstationary white noise is then determined using the method of Fokker-Planck. The more general result obtained here is reducible to the known solution associated with stationary excitation. Author

N63-15421 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PERIODIC SOLUTIONS OF THE RESTRICTED THREE BODY PROBLEM REPRESENTING ANALYTIC CONTINUATIONS OF KEPLERIAN ELLIPTIC MOTIONS
Richard F. Arenstorf Washington, NASA, May 1963 18 p 10 refs
(NASA TN D-1859) OTS: $0.50

A detailed mathematical proof is given in this report for the following new result: In the restricted three-body problem with small mass ratio, there exist one-parametric analytic families of synodically closed solution curves, which are near rotating Keplerian ellipses with rational sidereal frequencies and appropriate positive eccentricities. Author

N63-15460 RAND Corp., Santa Monica, Calif.
ORBIT DETERMINATION AS A MULTIPOINT BOUNDARY VALUE PROBLEM AND QUASILINEARIZATION
Richard Bellman, Harriet Kagiwada, and Robert Kalaba May 1962 12 p 4 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3129-PR)

Many problems in mechanics and applied mathematics, in general, require the solution of multipoint nonlinear boundary-value problems. A computational approach to their solution, based on the idea of quasi-linearization, is described and the results of an application to the computational determination of orbits are presented. Author

N63-15500 Illinois U. Coordinated Science Lab., Urbana
RATIONAL FUNCTION APPROXIMATION OF POLYNOMIALS WITH EQUIRIPPLE ERROR
DeVerl Humpherys Feb. 1963 95 p 32 refs
(Contract DA-36-039-SC-85122)
(R-159)

A method has been proposed whereby any polynomial can be approximated in an equiripple manner by a rational function. The properties and form of this rational function are discussed. Several examples are used to illustrate the theory. Most of these examples are chosen so that the approximating rational function can be identified as a network-function part; in particular, the group delay has been given special emphasis. The ideal group delay vs. frequency characteristic of filter is a constant. This type of group delay is approximated in an equiripple manner. In addition, a numerical scheme is proposed so that, from a given crude equiripple approximation, a more exact solution can be obtained. An example used to illustrate this approach is the problem of compensating the nonconstant group delay characteristics of a sharp-cutoff low-pass filter. Author

N63-15522 Atomic Energy Commission. Div. of Technical Information, Washington, D. C.
EINE ANALYTISCHE LOSUNGSMETHODE FÜR DAS ENERGIEABHANGIGE NEUTRONENTRANSPORTPROBLEM (AN ANALYTICAL METHOD OF SOLUTION FOR THE ENERGY DEPENDENT NEUTRON TRANSPORT PROBLEM)
Hans Hejtmanek (Autominstitut der Osterreichischen Hochschulen, Vienna) July 10, 1962 9 p 5 refs Transl. by D. H. Roy from Atomkernergie (Munich), v. 6, no. 9, Sept. 1961 p 350–353
(AEC-TR-5204)

The energy-dependent neutron-transport problem is treated here for plane geometry. The integral equation for the problem is derived from first principles and this equation is solved using a Fourier-Mellin transform. D.E.R.

N63-15523 Stanford U. Applied Mathematics and Statistics Lab., Calif.
CALCULATION OF PARTICULAR SOLUTIONS OF LINEAR PARTIAL DIFFERENTIAL EQUATIONS BY THE METHOD OF INTEGRAL OPERATORS
Stefan Bergman and John G. Herriot Aug. 13, 1962 44 p 10 refs
(Contract Nonr-225(11)(NR-041-086); Nonr-225(37) (NR-044-211))
(Tech. Rept.-112 and Tech. Rept.-24)

The solution U for linear partial-differential equations of the form $\tilde{L}(\tilde{U})\ \tilde{U}_{xx} + \tilde{U}_{yy} + a\tilde{U}_x + b\tilde{U}_y + c\tilde{U} = 0$ is derived using the method of particular solutions. The method assumes that the boundary C is a closed curve which is a sum of a finite number of analytic curve segments. A set of numerical procedures is described which permits the evaluation of an integral operator, and thus the computation of the values of a set of particular solutions and their derivatives at a number of points (x,y). This method is useful in determining the particular solutions of boundary-value problems, eigenvalues and eigenfunctions, nonlinear boundary-value problems, and flow pattern construction for incompressible fluids. Sample calculations carried out, using the Burroughs ALGOL 60 procedures, are included. M.P.G.

N63-15575 Iowa State U. of Science and Tech., Ames
SOME ASPECTS OF CONSTRAINED RANDOMIZATION [Interim Technical Report]
Gary J. Sutter, George Zyskind, Oscar Kempthorne Wright-Patterson AFB, Ohio, Aeronautical Res. Labs., Jan. 1963 36 p 34 refs
(Contract AF 33(616)-8269)
(ARL-63-18)

The definition of constrained sets of plans and the problems to be considered are given. A correspondence between constrained sets of plans and RT × RT square arrays and a correspondence between constrained sets of plans and resolvable balanced incomplete block designs are given. These correspondences led to the enumeration of many constrained designs. Some relationships between the variance of the error sum of squares under complete randomization and under constrained randomization are given. The power of the randomization test under constrained randomization was considered for nearly linearly, randomly, and semirandomly

distributed basal yields. The empirical results exhibit a tendency of the sensitivity of the test for the detection of treatment differences to increase with decreases in the variance of the error sum of squares of the constrained sets. Author

N63-15633 Minneapolis-Honeywell Regulator Co. Military Products Group, Minn.

APPLICATIONS OF OPTIMIZATION THEORY. SECTION II—THE EQUIVALENT MINIMIZATION PROBLEM AND THE NEWTON-RAPHSON OPTIMIZATION METHOD

D. K. Scharmack *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11–13 Sept. 1962 p 119–158 9 refs (See N63-15626 12-01)

(Contract AF 33(657)-7383)

The problem of finding the optimum path from an initial condition to a target set is considered. The problem is reduced to an initial value problem in which the minimizing initial values of the adjoint variables or multipliers are sought. The problem then becomes one of minimizing a function of several variables are subject to constraint conditions and whose necessary and sufficient conditions for establishing a strong minimum are well known. The second-order Newton-Raphson iteration procedure for numerically finding the minimum is described. Finally, experiences using the Newton-Raphson method are described. D.E.R.

N63-15639 Harvard U., Cambridge, Mass.

OPTIMAL PROGRAMMING OF MULTIVARIABLE CONTROL SYSTEMS IN THE PRESENCE OF NOISE

Arthur E. Bryson, Jr. *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11–13 Sept. 1962 p 343–351 (See N63-15626 12-01)

This paper is a brief review of the current status of optimal-programing theory as applied to multivariable control systems in the presence of noise. Open-loop programing of control variables for a noise-free nonlinear system is discussed first, followed by a description of closed-loop gain programing for a linearized version of the same type of system. Optimal filtering of noisy measurements is then reviewed for linear time-varying systems. A combination of these techniques promises to provide optimal control for a wide class of systems and performance indices. Author

N63-15640 Harvard U., Cambridge, Mass.

SMOOTHING FOR LINEAR AND NONLINEAR DYNAMIC SYSTEMS

Arthur E. Bryson, Jr. and Malcolm Frazier (Raytheon Co.) *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11–13 Sept. 1962 p 353–364 2 refs (See N63-15626 12-01)

A method is presented for making maximum likelihood estimates of the state variables of linear and nonlinear dynamic systems over a finite time interval, utilizing measurements made during this time interval and, if available, *a priori* estimates of the initial conditions and the forcing functions. For a linear system, the filtering results are identical to those of Kalman and Bucy; the smoothing result is an extension of their work. Author

N63-15641 RIAS, Div. of Martin Co., Baltimore, Md.

FIRST ORDER IMPLICATIONS OF THE CALCULUS OF VARIATIONS IN GUIDANCE AND CONTROL

R. E. Kalman *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11–13 Sept. 1962 p 365–371 5 refs (See N63-15626 12-01)

The principal contribution of this paper is the recognition and correlation of the relation between Caratheodory's classification of regular extremals and the theory of controllability. The correlation technique used may be applied to many problems of trajectory optimization with profitable results because of its proximity to the Jacobi determinant which is necessary to locate conjugate points. D.E.R.

N63-15642 Aerospace Corp., El Segundo, Calif.

A SYNTHESIS METHOD FOR OPTIMAL CONTROLS

Lucien W. Neustadt *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11–13 Sept. 1962 p 373–381 12 refs (See N63-15626 12-01)

A method is suggested for computing optimal controls. This method is based on the Pontryagin maximum principle, and consists in periodically computing the appropriate initial conditions of the linearized adjoint system as a function of the state-of-the-system. The adjoint system is then used to determine the optimal control. Detailed computational procedures, using a steepest ascent method of successive approximations, are developed for some specific optimal problems including the "bang-bang" time-optimal and minimum-control energy problem. Author

N63-15643 Minneapolis-Honeywell Regulator Co., Minn.

ON OPTIMAL CONTROL FOR SYSTEMS WITH NUMERATOR DYNAMICS

C. A. Harvey, E. B. Lee, and L. Markus (Minn. U.) *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11–13 Sept. 1962 p 383–395 4 refs (See N63-15626 12-01)

(NASA Contract NASr-27)

Modes of control, conditions for time-optimal control, and the construction of mathematical models of time-optimal controllers for systems with numerator dynamics are given. A specific numerator dynamics system is the small amplitude pitch motions of aircraft. These motions are mathematically calculated to apply to both general and recurrent systems. D.E.R.

N63-15647 European Atomic Energy Community, Brussels (Belgium)

"CANDIDE"—PLAN D'ENSEMBLE SUR LES DEVELOPPMENTS POSSIBLES DU COUPLAGE DES CALCULATEURS ANALOGIQUES ET DIGITAUX DU CETIS ("CANDIDE"—OVERALL PLAN ON POSSIBLE DEVELOPMENTS OF COUPLING THE ANALOG AND DIGITAL COMPUTERS OF CETIS)

A. Riotte Joint Nuclear Research Center, Ispra Establishment (Italy), European Scientific Information Processing Center, 1963 18 p In French; English abstract

(CETIS Rept. 33; EUR 150.f) Available from the Belgian American Bank and Trust Co., N.Y., account No. 121.86: 40 Belg. Fr.

The necessary studies in the linkages between analog and digital computers in CETIS are described. Two types of linkages are discussed: (1) one directional static linkage (structural linkage), by which we place the analog computer under the direct or indirect control of the digital computer in the problem setup phase; (2) the problem input to the computer being under the form of a program in APACHE code, two-directional dynamic linkage. After A-D conversion, the digital computer supplies the analog variables to the analog machine through D-A converters. This includes the use of a digital computer as a function generator. Author

N63-15691 Stanford U. Applied Mathematics and Statistics Lab., Calif.

ON COMPLETE MINIMAL SURFACES

Robert Osserman Mar. 20, 1963 27 p 14 refs

(Grant DA ARO(D)31-124-G80)

(Tech. Rept. 22)

This report continues an investigation of global properties of minimal surfaces initiated in a previous paper, where attention was

devoted chiefly to the simply-connected case. This report considers surfaces of higher connectivity and of arbitrary genus. In particular, questions such as boundary behavior and total curvature, where one cannot simply pass to the universal covering, are treated. Author

N63-15702 RAND Corp., Santa Monica, Calif.
USES OF MONTE CARLO IN PERT
Richard Van Slyke Feb. 1963 28 p 9 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3367-PR)

The mathematical assumptions underlying the PERT (Program Evaluation and Review Technique) management system are of doubtful validity, and, even granting these assumptions, there are still serious computational difficulties involved in getting the desired answers. This report outlines some of the weaknesses of the present system, and suggests how the use of Monte Carlo methods can lead to improvement, first in allowing less restrictive mathematical assumptions to be made, and second in extending the kinds of computational results that can be obtained. Moreover, the method can be used to check the validity of the commonly used approximations. A "criticality index" for an activity is defined; it is the probability that an activity will lie on a critical path. This is an example of a quantity that can be calculated by Monte Carlo methods, but not by presently used methods. An experimental computer program for Monte Carlo treatment of PERT networks has been coded for the IBM-7090 computer. The program is discussed, and some shortcuts are suggested for reducing the time of computation. Author

N63-15703 Wisconsin U., Madison
THE ATYPICAL ZEROS OF A CLASS OF ENTIRE FUNCTIONS Technical Summary Report
P. M. Anselone and R. P. Boas, Jr. Apr. 1963 9 p 5 refs
(Contract DA-11-022-ORD-2059)
(MRC-394)

A homogeneous differential-difference-integral equation with constant coefficients and a convolution integral has an exponential solution $\phi(t) = e^{zt}$ if, and only if, z is the zero of a certain entire function. This paper is concerned with the asymptotic distribution of the zeros of such entire functions. Author

N63-15712 Burroughs Corp., Detroit, Mich.
DESIGN REPORT FOR THE UNIVERSAL GROUND TEST PROGRAM MOD III COMPUTING SYSTEM ATLANTIC MISSILE RANGE
Apr. 8, 1963 50 p
(Contract AF 04(695)-28)
(Rept. 411-63-177)

This report describes the utilization and operation of the computer program developed by Burroughs and designated the Universal Ground Test Program. The Purpose of the Universal Ground Test Program (UGT) is to enable the Mod III Computing System to support all types of ground tests for any mission, using one standard, highly flexible computer program which can be contained in a single Instruction Memory tray. This standard program approach allows the computing system to participate in joint or simultaneous countdowns, a capability required by Project Gemini. Author

N63-15752 Lockheed Missiles and Space Co., Sunnyvale, Calif.
NONLINEAR ORDINARY DIFFERENTIAL EQUATIONS; AN ANNOTATED BIBLIOGRAPHY.
George R. Evans, comp. Mar. 1963 115 p 176 refs
SB-62-54

The primary area of interest is the existence and uniqueness of solution to ordinary differential equations for the following two classes of problems: (1) initial value problems, and (2) boundary value problems. Also included are actual construction of solutions. Excluded are stability of solutions and equations with periodic solutions, or equations with periodic coefficients. Arrangement is chronological and the period covered is 1949 to October 1962. Author

21 METEOROLOGY

Includes: climatology; weather forecasting; lower atmosphere studies; and oceanography.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N63-15346 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CROSS SECTIONS OF TEMPERATURE, PRESSURE, AND DENSITY NEAR THE 80TH MERIDIAN WEST
Orvel E. Smith, William M. Mc Murray, and Harold L. Crutcher Washington, NASA, May 1963 159 p 21 refs
(NASA TN D-1641) OTS: $3.00

This report provides monthly and annual temperature, pressure, and density analyses along the 80th meridian west from the surface to 31 km. These parameters are furnished at constant altitudes and are based on 3 years of data, 1957 to 1960. The information is given in mean and standard deviation values for each element. Author

N63-15428 Instituto y Observatorio Astronomico de Marina, San Fernando (Spain)
ANALES DEL INSTITUTO Y OBSERVATORIO DE MARINA. SECCION 3.ª: OBSERVACIONES METEOROLÓGICAS Y MAGNÉTICAS CORRESPONDIENTE A LOS AÑOS 1957-1958 [ANNALS OF THE MARINE INSTITUTE AND OBSERVATORY. SECTION 3.ª: METEOROLOGICAL AND MAGNETIC OBSERVATIONS FOR THE YEARS 1957-1958]
F. Fernandez de la Puente 1962 151 p In Spanish

Tables on the magnetic and meteorological data obtained by observations at the marine observatory in San Fernando, Spain, are presented for the years 1957 and 1958. D.E.R.

N63-15532 Hanford Atomic Products Operation, Richland, Wash.
DUAL ATMOSPHERIC TRACER TECHNIQUES FOR DIFFUSION STUDIES USING PHOSPHORESCENCE-FLUORESCENCE ANALYSIS
J. D. Ludwick Apr. 18, 1963 19 p 2 refs
(Contract AF(45-1)-1350)
(HW-70892)

An analytical technique was developed for wind studies to determine the effect of height of release on ground-level dosage patterns. Two atmospheric tracers, zinc sulfide and fluorescein, may be simultaneously dispersed at varying altitudes and collected downwind on molecular filters. These filters are dissolved in an ethanol-ethyl acetate solution and the zinc sulfide content measured by electronic counting of the phosphorescence. After centrifuging, to eliminate interference from zinc sulfide or dust particles and alcoholic KOH addition, the fluorescein content was determined from the solution fluorescence utilizing a spectrofluorometer. Author

N63-15719 Army Missile Command. Directorate of Research and Development, Redstone Arsenal, Ala.
WIND, WIND SHEAR AND TURBULENCE REPRESENTATION FOR ATMOSPHERIC BALLISTICS
Oskar Essenwanger Apr. 1, 1963 32 p 10 refs
(RR-TR-63-7)

The purpose of this report is to present an analysis of the effect of wind on atmospheric ballistics. The analysis will supplement and interpret compilations of wind data such as is given in the Climatological Ring-book. The four major topics of the analysis are: the vertical profile, the profiles with maximum wind speeds, the wind shear, and the turbulence parameters. Author

22 NAVIGATION AND GUIDANCE

Includes: autopilots; star tracking; inertial platforms; and traffic control.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; 20 Mathematics; and 29 Space Sciences.

N63-15318 Bundesministerium für Verkehr, Bonn (W. Germany)

DAS FLUGFOLGEPROBLEM, 2. TEIL. EINIGE UNTERSUCHUNGEN DES BEWEGUNGSABLAUFS IM NAHVERKEHRSBEREICH VON FLUGHÄFEN [FLIGHT FLOW PROBLEM, PART 2. AIR TRAFFIC CONTROL STUDY OF AN AIRPORT AREA]

E. Rossger and H. von Villiez Düsseldorf, VDI-Verlag GmbH, 1963 42 p 30 refs In German

(*Its* Luftfahrt-Forschungsberichte 16)

Discussions of air traffic control in airport areas include: (1) the use of radar for flight observations and for the measurement of distances, (2) the photographic recording of radar images, (3) the traffic picture in airport areas, and (4) the accuracy of aircraft guidance. I.v.L.

N63-15335 Bendix Corp. Bendix Radio Div., Towson, Md.

AUTOMATIC LANDING SYSTEM STUDY. PART II: RESULTS OF GROUND EQUIPMENT AND DATA TRANSMISSION STUDIES

R. Wilkie, C. Smearmon, and R. Cope Wright-Patterson AFB, Ohio, Flight Control Lab., Feb. 1962 197 p 4 refs

(Contract AF 33(616)-6925)

(ASD-TR-61-114, Pt. II)

This volume contains the results of airborne equipment studies. The studies were concerned with scanning-beam transmitting systems which generate coordinate references with respect to the runway. The state-of-the-art capabilities of a range-elevation angle, a biangular, and a rectangular coordinate system were studied with respect to position accuracy and noise content. These results were compared to the results of the airborne equipment studies to determine the compatibility of the various landing schemes. Author

N63-15399 Aberdeen Proving Ground. Ballistic Research Labs., Md.

ORDVAC PROGRAMS FOR STAR IDENTIFICATION AND COMPUTATION OF STANDARD COORDINATES

A. Roberta Wooten Jan. 1963 58 p 6 refs

(BRL-MR-1451)

Using the camera-orientation elements (α, ω, κ, c, x_p, y_p) derived from several known stars or determined from instruments, the "Star Identification Program" serves to identify all other photographed stars. After proper identification, the "Computation of Standard Coordinates Program" is used to compute the coordinates of the control points for the camera orientation described in BRL Report No. 1065, "A General Solution to the Problem of Photogrammetry" by Hellmut H. Schmid. Author

23 PHYSICS, GENERAL

Includes: acoustics; cryogenics; optics; and thermodynamics.

For astrophysics see: 05 Astronomy and Astrophysics.

For related information see: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 24 Physics, Solid-State.

N63-15262 Bettis Atomic Power Lab., Westinghouse Electric Corp., Pittsburgh, Pa.

A NUMERICAL METHOD FOR THE DETERMINATION OF THE EFFECT OF PLANT CHARACTERISTICS ON CORE POWER TILT

J. V. Reihing, Jr., and J. E. Funk *In its* Bettis Technical Review Reactor Technology Mar. 1963 p 1–20 1 ref (See N63-15261 12-10) OTS: $2.00

A numerical method for the determination of the effect of nuclear-reactor-plant characteristics on reactor core-power distribution is described. This technique can be used, for example, to investigate the effect of steam generator heat-removal capabilities upon core power tilt. In addition to a list of plant characteristics, the method assumes a knowledge of total reactor core power, the distribution of core power in terms of the deviations of the average temperatures of the core quadrants from the overall core average temperature, and the flow and energy redistributions that occur in the reactor inlet and exit plenums. The method is cast in matrix notation, and a computational procedure for the solution of the set of matrix equations is suggested. Author

N63-15263 Bettis Atomic Power Lab., Westinghouse Electric Corp., Pittsburgh, Pa.

USE OF GADOLINIUM SEPTA IN SLAB CORES

J. J. Kepes and J. A. Mitchell *In its* Bettis Technical Review Reactor Technology Mar. 1963 p 21–26 9 refs (See N63-15261 12-10) OTS: $2.00

The nuclear characteristics of gadolinium in septa form have been predicted and compared to experiment in three critical assemblies. These cores were designed to provide different spectral environments for sheets of 4.3 w/o gadolinium in zirconium. Two diffusion-theory models were examined. A variational method predicted the k_{eff} to within +0.3% and −1.4%, whereas an iterative treatment was 1% to 2% low. Author

N63-15264 Bettis Atomic Power Lab., Westinghouse Electric Corp., Pittsburgh, Pa.

SPACE AND TIME SYNTHESIS BY THE VARIATIONAL METHOD

S. Kaplan and J. A. Bewick *In its* Bettis Technical Review Reactor Technology Mar. 1963 p 27–44 15 refs (See N63-15261 12-10) OTS: $2.00

A class of approximation methods which are being developed to reduce the cost of solving certain problems in reactor physics is described. These methods construct approximate solutions to many-dimensional problems by combining solutions to fewer-dimensional problems, using variational principles to determine the manner of combination. Several numerical examples are given which show the methods to be very satisfactory. The variational principles are described and discussed in the context of general approximation methods of the weighted residual type. Author

N63-15265 Bettis Atomic Power Lab., Westinghouse Electric Corp., Pittsburgh, Pa.

THE DETERMINATION OF THE DENSITY OF CERAMIC FUEL WAFERS BY RADIATION METHODS

H. H. Lang *In its* Bettis Technical Review Reactor Technology Mar. 1963 p 45–52 1 ref (See N63-15261 12-10) OTS: $2.00

Measuring the thickness of a material and the attenuation of a collimated beam of radiation passing through the material provides a method of rapidly determining its density. Gages based upon this principle have been developed and used to determine the density of PWR Core 2 seed and blanket wafers. An inspection rate of one wafer per minute has been achieved. For the blanket wafers, the precision of the gage method is greater than that of the wet density method; for the seed wafers, it is equivalent. Author

N63-15273 Houston U., Tex.

THE EFFECT OF TEMPERATURE AND CARRIER GAS ON THE LOSS RATE OF TRITIUM FROM RADIOACTIVE FOILS

G. R. Shoemake, J. E. Lovelock, and A. Zlatkis [1962] 14 p 6 refs Submitted for Publication

(NASA Grant NsG-199-62) OTS: $1.60 ph, $0.80 mf

The effect of temperature and carrier gas upon the stability of tritium foils, which may find use as ionization detectors in gas chromatography for interplanetary probes, was investigated. Using a simple ionization chamber, the loss rate from radioactive titanium tritide impregnated copper foils was determined for various carrier gases at different temperatures based on a 50 millicurie source. The carrier gases used were hydrogen, helium, nitrogen, air, argon + 5% methane, and argon saturated with water vapor. Results indicated that: (1) The general accepted operating temperature for tritium foils was around 225° C. (2) When hydrogen was used as the carrier gas, leakage losses into the air became apparent at a much lower temperature than with the other gases. This is apparently due to an exchange between the hydrogen gas and the tritium contained on the foil as titanium tritide. (3) The occupation maximum permissible concentration of molecular tritium in air is 2×10^{-3} microcuries per cm^3. I.v.L.

N63-15288 California U., Santa Barbara

REFLECTION SPECTRUM OF CUBIC ZINC SULFIDE IN THE INTERBAND TRANSITION REGION

W. C. Walker and J. Ostantowski Repr. from J. of the Opt. Soc. of Am., v. 53, no. 3, Mar. 1963 p 399–400 3 refs

(NASA Grant NsG-91-60)

A program of study is underway of photon-electron interactions in the spectral region from λ4000-400 Å ($h\nu$ from 3 ev to 29 ev). Absolute reflection measurements of a cleaved single crystal of zinc sulfide has been made. The reflection spectrum was obtained at room temperature and at an angle of incidence of 20°. The crystal was cleaved immediately before mounting in the vacuum reflectometer which was maintained at 10^{-15} Torr during the measurements. Slitwidths of 200μ were used with a one-half meter Seya-Namioka monochromator giving a band pass having a half-width of 3.4 Å. The average wavelength interval between measured points over the 3000 Å range was about 30 Å so that points were obtained with an energy resolution better than 0.1 ev for most of the spectrum. This structure is remarkably similar to that reported by Ehrenreich, Phillip, and Phillips for several III-V compounds having the zincblende structure. By analogy with their work, the peaks in zinc sulfide can be assumed to be due to interband transitions between points of high symmetry in the Brillouin zone. Although it is almost impossible to identify these peaks with specific transitions without detailed band structure calculations, the similarity of the spectrum to that of other materials having the zincblende structure indicates that the same transitions are involved. I.v.L.

N63-15294 Wisconsin U. Theoretical Chemistry Inst., Madison

COMMENT ON THE USE OF UNITED-ATOM EXPANSIONS

Werner A. Bingel Repr. from J. of Chem. Phys., v. 38, no. 1, Jan. 1, 1963 p 274–275

(NASA Grant NsG-275-62)

The validity of united-atom expansion in powers of R, such as was proposed by R. A. Buckingham and D. M. Duparc (1962) for the very short-range interactions of hydrogen atoms and helium atoms, is investigated. In their equation the R^4 term gives only the contribution of the first-order perturbation energy. Closer consideration of the second-order perturbation contribution to the R^4 term, using results of Kato on the Coulomb singularities of the atomic Hamiltonian, shows that the validity of expansion in terms of R is probably rather small for ground states. For excited states of the Rydberg type, the range of validity should be greatly extended as indicated by calculations on H_2^+ and comparisons with exact results. M.P.G.

N63-15298 Michigan State U., East Lansing

FIELD EMISSION IN A MAGNETIC FIELD

F. J. Blatt [1962] 15 p 12 refs

(Contract AF 49(638)-70)

An expression is derived for the field-emission current in a longitudinal magnetic field in the zero-temperature limit. Two cases, one corresponding to constant Fermi energy and the other to constant electron density, are considered. The expressions for the emission current in the two cases differ through the presence, in the latter, of an additional oscillatory term. It is thought that emission-current variations, especially in the case of fixed Fermi energy, may prove valuable in the study of surface effects in semimetals and some semiconductors, and for this reason, the emission current is numerically evaluated. D.E.R.

N63-15310 Uppsala U. Quantum Chemistry Group for Research in Atomic, Molecular and Solid-State Theory (Sweden)

APPLICATIONS OF LOCALIZED PERTURBATION TECHNIQUE

Richard F. Wood and M. Asgar Ali (Keele U., Gt. Brit.) Apr. 1, 1962 59 p refs

(Contract AF 61(052)-351)

(Tech. Note 75; ARL-63-27)

Applications have been made of the localized perturbation technique for conjugated systems within the framework of Hückel theory by using the inverse of cyclic matrices in closed analytical form in terms of Chebyshev polynomials by the method of Löwdin, Pauncz, and de Heer. It is shown that by this approach, one can get the exact energy levels and eigenfunctions of perturbed conjugated systems by a simple noniterative method for simple perturbations, and by a second-order iteration process for complicated perturbations which reduces the numerical "size" of the problem considerably. Possible applications of this technique in other related fields are discussed. Author

N63-15375 Argonne National Lab., Ill.

ALPHA-GAMMA ANGULAR CORRELATION MEASUREMENTS WITH LIQUID SOURCES

Elias Smith Murphy, Jr. Feb. 1963 65 p 81 refs

(Contract W-31-109-eng-38)

(ANL-6685)

Alpha–gamma angular correlation measurements have been made with solid sources of Am^{243} and with liquid sources containing either Am^{243} or an even–even alpha emitter in dilute perchloric acid solutions. Even–even alpha emitters which have been studied are U^{232}, Th^{230}, and Ra^{226}. Thicknesses of the solid sources were controlled so that the neptunium recoils from one source were stopped in Am_2O_3, while recoils from the other sources were stopped in the aluminum, gold, or mica backing on which the sources were vaporized. The liquid sources were films consisting of 3 microliters of solution placed between a rubber hydrochloride membrane and a microscope cover glass, 1 cm^2 in circular cross section. The perchloric acid concentration of the liquid sources ranged from 0.5 to 3.0 molar. All of the angular correlations obtained with solid Am^{243} sources were attenuated, the average attenuation coefficients being 0.29 ±0.01 for sources in which recoils were stopped in Am_2O_3, 0.20 ±0.01 for sources in which

recoils were stopped in mica, 0.52 ± 0.02 for sources in which recoils were stopped in gold, and 0.67 ± 0.01 for sources in which recoils were stopped in aluminum. Unattenuated angular correlations were obtained with liquid sources containing Am^{243} in 0.5 M and 1.0 M $HClO_4$. For liquid sources containing Am^{243} in 3.0 M $HClO_4$, the correlation was attenuated, with an average attenuation coefficient of 0.86 ± 0.01. Attenuated angular correlations were also found with liquid sources containing an even–even nuclide in dilute aqueous solutions. The average attenuation coefficients for the even–even nuclide liquid sources were $G_2 = 0.75 \pm 0.05$ and $G_4 = 0.86 \pm 0.03$ for U^{232}, $G_2 = 0.64 \pm 0.06$ and $G_4 = 0.84 \pm 0.04$ for Th^{230}, and $G_2 = 0.76 \pm 0.11$ and $G_4 = 0.90 \pm 0.07$ for Ra^{226}. The postulate that the measured angular correlation function for Am^{243} is attenuated by the same amount as the correlation functions for the even–even nuclides is found to be untenable, since it requires unreasonable alpha mixing ratios or unreasonable admixtures of M2 to E1 gamma radiation in the Am^{243} decay process. The attenuation observed with even–even nuclide sources is believed to be consistent with the postulate of a time-dependent electric interaction. Author

N63-15381 Los Alamos Scientific Lab., N. Mex.
SYMMETRY OF NEUTRON INDUCED U^{235} FISSION AT INDIVIDUAL RESONANCES
G. A. Cowan, B. P. Bayhurst, and R. J. Prestwood Apr. 17, 1963 21 p 4 refs
(Proj. GNOME)
(PNE-114F) OTS: $0.50

Neutrons from the Project Gnome nuclear test were resolved in energy by time-of-flight and used to study symmetry of fission in U^{235} in the resonance region. Symmetry was deduced by measurement of the fission product ratio Ag^{111}/Mo^{99} at resonances from 8.8 ev to 40 ev. The maximum decrease observed in the probability of symmetric fission as compared to the probability in thermal fission of U^{235} was 50%. The maximum increase observed was 22%. Four levels showed an increase in symmetry. Thirteen levels showed a decrease in symmetry. With the exception of one level at 15.4 ev, assignments of levels by symmetry are in agreement, in the region covered, with previous work. Author

N63-15391 Carnegie Inst. of Tech., Pittsburgh, Pa.
INTERPRETATION OF EXPERIMENTAL MOSSBAUER SPECTRUM AREAS Technical Report No. 1
George Lang Apr. 22, 1963 15 p 2 refs
(Contract Nonr-760(20))

The method of Shirley and co-workers for interpreting Mossbauer spectrum areas is reformulated and extended to more general line shapes. The treatment is independent of source line shape and may be applied to multiple line absorbers, provided that the contribution to the spectrum of a given absorber line is distinct. Author

N63-15442 Comitato Nazionale per l'Energia Nucleare. Lab. Nazionali, Frascati (Italy)
INTEGRALI NELLO SPAZIO DELLE FASI PER SISTEMI DI DUE E TRE PARTICELLE [PHASE-SPACE INTEGRALS FOR TWO AND THREE PARTICLE SYSTEMS]
G. Sette Dec. 20, 1962 15 p 4 refs In Italian
(*Its* Nota Interna 175; LNF-62/108)

Equations are derived for the function of distribution of angles and maximum energy, $f(\theta,\phi,E_o)$, and for E_o, the maximum energy for relativistic two- and three-particle systems. Trans. by P.F.E.

N63-15446 California U., Livermore. Lawrence Radiation Lab.
NORMALIZATION OF THE EPITHERMAL U^{235} FISSION CROSS SECTION
C. D. Bowman, G. F. Auchampaugh, and S. C. Fultz Feb. 14, 1963 16 p 3 refs
(Contract W-7405-eng-48)
(UCRL-7061) OTS: $0.50

Additional experiments have been carried out to corroborate values for the fission cross section of U^{235} between 5 and 60 ev, as presented in UCRL-6926. The energy dependence of the neutron flux has been restudied, the effects of neutron scattering have been investigated, and the backgrounds have been more thoroughly measured. The background corrections given in UCRL-6926 were found to be unnecessary. The results of these studies confirm the normalization reported in UCRL-6926. Author

N63-15450 Comitato Nazionale per l'Energia Nucleare. Lab. Nazionali, Frascati (Italy)
ABERRAZIONI IN OTTICA DEI MAGNETI A SIMMETRAI DI RIVOLUZIONE [ABERRATIONS IN OPTICS OF SYMMETRICALLY REVOLVING MAGNETS]
P. Giupponi Feb. 4, 1963 20 p 10 refs In Italian
(*Its* Nota interna 185; LNF-63/5)

The problems of aberrations that exist in corpuscular optics when the condition of linear approximations is not satisfied is studied. Equations are developed for first-order electron optics and third-order aberrations for the case of the optics of a symmetrical system of revolution. Chromatic and spherical aberrations must be considered in the design of new apparatus for focusing small particle beams; geometrical aberrations cannot be neglected in the design of television tubes and electron microscopes. Trans. by P.F.E.

N63-15461 Uppsala U. Quantum Chemistry Group for Research in Atomic, Molecular and Solid-State Theory (Sweden)
THE STRUCTURE OF FERMION DENSITY MATRICES
A. J. Coleman June 1, 1962 59 p 95 refs
(Contract AF 61(052)-351)
(TN-80; ARL-62-440)

This paper studies the question "What conditions do fermion statistics of a system impose on its density matrices of various orders?" Author

N63-15464 Sandia Corp., Albuquerque, N. Mex.
TABLES OF THE DISTRIBUTION OF THE COEFFICIENT OF COHERENCE FOR STATIONARY BIVARIATE GAUSSIAN PROCESSES
D. E. Amos and L. H. Koopmans Mar. 1963 327 p 25 refs
(SCR-483; Sandia Corp. Monograph) OTS: $4.00

Equations are derived for the coefficient of coherence and are used to calculate the probability density and the cumulative distribution for stationary bivariate guassian processes. The tables were computed on a CDC 1604 computer using floating point arithmetic. Uses for the tables include: computation of the bias and mean-square-error of the coefficient of coherence, construction of power function for tests of hypotheses concerning the frequency, and experimental design. R.C.M.

N63-15486 California U., Livermore. Lawrence Radiation Lab.
NUCLEAR CHARGE DISTRIBUTION IN SYMMETRIC FISSION-Sn^{121} INDEPENDENT YIELD
Arthur C. Wahl (Washington U.–,St. Louis, Mo.) and David R. Nethaway Mar. 18, 1963 11 p 8 refs
(Contract W-7405-eng-48; Grant NSF-G-22296)
(UCRL-7280) OTS: $0.50

Fifteen nuclear experiments are presented as evidence against the theorem that the preferred distribution of nuclear charge, i.e., the most probable charge, Zp, remains near 50 over a large range of mass numbers, which would explain the observed large decrease in the total kinetic energy of fission fragments as their mass ratio approaches unity. The evidence presented supports the theorem that many prompt neutrons are evaporated from fragments of near equal mass. The experiments involved the irradiation of Sn-122 O_2 and Sn-124 O_2 with 25-mev bremsstrahlung producing isomer

states of indium-121 and indium-123. It is found that these isotopes have mass numbers of 121 and 123, with Zp values of less that 50 and most probably less than 48.9. D.E.R.

N63-15487 California U., Berkeley. Lawrence Radiation Lab.
HYPERFINE-STRUCTURE STUDIES OF Er^{169} AND ISOTOPES OF REFRACTORY ELEMENTS
Walter M. Doyle (Ph. D. Thesis) Jan. 23, 1963 85 p 40 refs
(Contract W-7405-eng-48)
(UCRL-10609) OTS: $2.00

The atomic-beam magnetic-resonance method has been used to investigate the electronic and nuclear properties of Er-169 and to determine the spins of several refractory-group nuclides. The apparatus used in the erbium research was sufficiently accurate to allow measurement of the nuclear dipole moment directly through its interaction with the external magnetic field. Beams of refractory metals were produced by electron bombardment of narrow wire sources, and the spins of several nuclides were measured. These are listed along with the half-lives and the electronic states in which resonances were observed. Author

N63-15497 General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.
THERMAL NEUTRON DIFFUSION LENGTH MEASUREMENTS IN LIGHT WATER FROM 20° C TO 90° C
J. L. Russell, Jr., W. C. Ballowe, W. R. Morgan, and W. V. Mosgovoy
AEC Div. of Tech. Inform., Apr. 1962 25 p 16 refs
(Contract AT(04-3)-189)
(GEAP-4018) OTS: $0.50

The diffusion length of thermal neutrons in light water was measured as a function of temperature in the range 20° C to 90° C for both pure water and poison solutions. Various concentrations of three poisons—H_3BO_3, $CdSO_4$ and Gd $(NO_3)_3$—were used in this experiment. The thermal neutron source was the thermal column of the General Electric Nuclear Test Reactor. The "water gun" apparatus was utilized for the measurements. Author

N63-15531 Battelle Memorial Inst., Columbus, Ohio
RELEASE OF FISSION GASES FROM UO_2 DURING AND AFTER IRRADIATION
James B. Melehan, Russell H. Barnes, John E. Gates, and Frank A. Rough Mar. 26, 1963 54 p 11 refs
(Contract W-7405-eng-92)
(BMI-1623) OTS: $1.25

Sintered UO_2 specimens with densities 82, 92, and 99 percent of theoretical were irradiated in a beam tube of the BRR, and the fission gases released during irradiation were collected for gamma-ray spectrometric determination of release rates for several fission-gas isotopes. In-pile and out-of-pile release at temperatures to 1650° C was studied. In the range 1000° to 1650° C the diffusion coefficients for Xe^{133}, Xe^{135}, and Kr^{85m} were expressed by the relation

$D = D_0 \exp\frac{-Q}{RT}$, where $D_0 = 2.0 \times 10^{-3}$ to 4.6×10^{-3} cm^2 per sec and Q = 87 to 92 kcal per mole. Below 1000° C, the in-pile gas release rates were relatively insensitive to changes in temperature, suggesting that diffusion was not occurring, and that diffusion coefficients are of doubtful significance in describing gas release below about 1000° C under in-pile conditions. The experimental relation between gas-release rate and the fission-gas half-life also suggested that below 1000° C, diffusion was not the principal in-pile release mechanism. It was also observed that the release below 1000° C was not the result of only a simple recoil mechanism. The reasonable agreement between in-pile and out-of-pile diffusion coefficients above 1000° C suggests that, for low burnups, accurate diffusion data can be obtained during postirradiation annealing out-of-pile. For specimen densities in the range of 92 to 99 percent of theoretical, the equivalent-sphere model for expressing fuel-surface geometry led to consistent results in analysis of gas-release by volume diffusion. Author

N63-15543 United Nuclear Corp. Development Div., White Plains, N.Y.
METHODS IN MONTE CARLO SOLUTION OF THE RADIATION TRANSPORT EQUATION Final Report, 20 Mar. 1961-31 May 1962
M. H. Kalos Army Chemical Center, Md., Nuclear Defense Lab., May 1962 50 p 7 refs
(Contract DA-18-108-405-CML-1007)
(UNC-5014, Vol. A; NDL-TR-36)

A discussion is given of certain methods of importance sampling and scoring in the Monte Carlo solution of the radiation transport equation. Author

N63-15565 Comitato Nazionale per l'Energia Nucleare. Lab. Nazionale, Frascati (Italy)
ACTIVITY AT THE NATIONAL LABORATORIES OF FRASCATI
Feb. 1963 44 p refs
(Rept. 13; LNF-63/11)

Laboratory activities and the operation of the electron-synchrotron at Frascati Laboratories are summarized. Included are: operation and experimentation with the electron-synchrotron, cryogenics, radiofrequency-electronics laboratories, magnet and magnetic measurements, technology, computer studies, and various service, and electron- and positron-storage ring studies. D.E.R.

N63-15569 Comitato Nazionale per l'Energia Nucleare. Lab. Nazionali, Frascati (Italy)
THE DECAY MODES $\eta^0 \rightarrow \gamma + e^+ + e^-$ AND $\eta^0 \rightarrow \gamma + \mu^+ + \mu^-$
E. Celeghini (Florence U.) and R. Gatto Mar. 25, 1963 5 p
(*Uts* Nota Interna 188; LNF-63/16)

The spectra and probabilities of eta-meson decay by the decay mode $\eta^0 \rightarrow \gamma + e^+ + e^-$ and the decay mode $\eta^0 \rightarrow \gamma + \mu^+ + \mu^-$ are calculated. A consideration of the invariant mass, m, of the two-lepton system and the v parameter (a parameter depending on the relative values of the residue of the poles and the subtraction constant, and related to the number of events) gives m_v = 750 mev. Using this value, the probability of the electron-positron decay mode is $(16.2 + 0.47v + 0.035\ v^2) \times 10^{-3}$; and the probability of muon-muon decay is $(55.8 + 21.9v + 2.74\ v^2) \times 10^{-5}$. M.P.G.

N63-15572 Comitato Nazionale per L'Energia Nucleare. Lab. Nazionali, Frascati (Italy)
ON THE DECAY OF THE η MESON
H. Shimodaira Nov. 26, 1962 14 p 10 refs
(*Uts* Nota Interna 169; LNF-62/99)

The decay of the η meson is estimated by considering higher mass contributions beside the ζ and ω. It is shown that the branching ratio $P(\eta \rightarrow 2\gamma)/P(\eta \rightarrow \pi^+\pi^-\pi^0)$ comes out well while we get a little larger ratio for $P(\eta \rightarrow \pi^+\pi^-\gamma)/P(\eta \rightarrow 2\gamma)$. Author

N63-15573 Comitato Nazionale per l'Energia Nucleare. Lab. Nazionali, Frascati (Italy)
NONPERTURBATIVE SOLUTION OF SMALL ANGLE SCATTERING PROBLEMS (MOLIERE'S APPROXIMATION)
C. Bernardini and C. Pellegrini Apr. 8, 1963 9 p 3 refs
(*Uts* Nota Interna 191; LNF-63/19)

A precedure is described which leads to a well-known result by Molière concerning the small angle scattering of a particle by

the potential due to an extended source. The basis of the method is the assumption that the Fourier transform of the potential falls down to zero rapidly enough at large wave numbers, e.g., there must be a cutoff at a characteristic momentum much smaller than that of the incoming or the outgoing particle. This procedure is somewhat more general and more intuitive than Molière's approximation. R.C.M.

N63-15678 Tennessee U., Knoxville

INFRARED SPECTRUM OF HYDROGEN FLUORIDE: SHAPES, POSITIONS AND INTENSITIES OF HIGH J LINES IN THE FUNDAMENTAL BAND Scientific Report No. 3

Lester F. Eldreth (M.S. Thesis) and Robert J. Lovell Dec. 1962 56 p 11 refs

(Contract AF 19(604)-7981)

(AFCRL-62-1090)

This report extends to lines m = −6 to m = +12 the study in the fundamental band of HF of the comparison between the theoretically predicted and experimentally determined rotational correction factors, $F_0^1(m)$. The trend of the experimental points from m = +8 to m = +12 is for an increasingly sharp drop below predicted values. Author

N63-15722 Hanford Atomic Products Operation, Richland, Wash.

THE RESPONSES OF VARIOUS DETECTOR SAMPLE ARRANGEMENTS FOR GAMMA-RAY SPECTROMETRIC MEASUREMENTS

R. W. Perkins Apr. 25, 1963 52 p 6 refs

(Contract AT(45-1)-1350)

(HW-68525) OTS: $1.25

The relative counting efficiencies and gamma-ray spectral responses of a number of NaI(Tl) detectors with various sizes of samples have been compared. The detectors used for these evaluations included solid crystals 3 inches in diameter by 3 inches thick and 9 inches in diameter by 4 inches thick, and well crystals 5 inches in diameter by 5 inches thick and 9⅜ inches in diameter by 8½ inches thick. Arrangements were evaluated with these detectors as summing systems, as coincidence summing systems, and in anticoincidence shielding. The responses of these systems and their relative efficiencies have been compared for point sources and for liquid sources ranging up to about 9 liters. Where size of the sample is unlimited, the maximum sensitivity for the measurement of a radioisotope usually is obtained by placing a large crystal within a large sample. The maximum photopeak-to-Compton ratio is available if a point source of the sample and anticoincidence shielding is used. The direct comparison of the responses from different sizes and shapes of samples for the various detector systems permits a good estimation of the relative sensitivities of the various systems for any specific application. For comparison with NaI(Tl) detectors, the response of a large plastic phosphor is included. Author

N63-15727 Carnegie Inst. of Tech., Pittsburgh, Pa.

SPHERICAL NUCLEI WITH SIMPLE RESIDUAL FORCES, PART I AND II Technical Report No. 11

Leonard S. Kisslinger (Western Reserve U.) and Raymond A. Sorensen Apr. 16, 1963 197 p

(Contract Nonr 760(15))

A review of spherical nuclei with simple residual forces includes: (1) a description of the Hamiltonian operator and wave functions, (2) energy level systematics, (3) odd–even mass differences, (4) magnetic dipole moments, (5) electric quadrupole moments, (6) electromagnetic transitions, and (7) beta decay. I.v.L.

N63-15728 General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio

REFRACTORY MATERIALS RESEARCH Tenth Quarterly Progress Report, 1 Jan. 1963–31 Mar. 1963

G. M. Kibler, T. F. Lyon, M. J. Linevsky, and V. J. De Santis Mar. 31, 1963 33 p 6 refs

(Contract AF 33(616)-6841; ARPA Order 24-62)

Design, fabrication, installation, and check-out apparatus modifications to be used in boride effusion studies continued. Design details and apparatus capabilities are discussed. In matrix isolation studies of vapor species over solid ZrO_2, the infrared spectra obtained in solid argon matrices are described and some structural assignments made. Evidence is quite conclusive that the only Zr-containing species is ZrO_2, and that the ZrO previously observed was due to interaction between ZrO_2 and the tungsten Knudsen cell. Resonance-line absorption measurements of both B and Zr atom lines in the vapor over the system ZrB_2-graphite have been completed, and thermodynamic property data therefrom are presented. In emissivity studies, work on pyrolytic graphite has been completed and emissivities of single crystal tungsten and on ASSET program specimens have been measured. Author

N63-15737 Rochester U. Inst. of Optics, N.Y.

RADIOMETRIC CONSIDERATIONS IN CURVED MIRROR GAS LASERS

Douglas C. Sinclair Mar. 20, 1963 18 p 5 refs

(Grant DA-ARO(D)-31-124-G139)

(AROD-3309-2)

In most of the anticipated applications of the gas laser, the beam must be collimated so that only that fraction of the total radiant flux which can be put in a collimated beam will be of use. It is shown in this report that, for practical purposes, the amount of radiant flux that can be put in a collimated beam is limited by the flux available in the TEM_{oo} mode (Transverse Electromagnetic Mode), and that one cannot increase the radiant flux in a higher order mode. It would thus appear that, in applications which involve collimating the laser beam, it is desirable to operate the laser in the TEM_{oo} mode, since the additional radiant flux contained in the higher order modes is not useful. Author

N63-15751 General Electric Co. Research Lab., Schenectady, N.Y.

DIRECT OBSERVATION OF INDIVIDUAL ADATOMS: NITROGEN ON TUNGSTEN

Gert Ehrlich and F. G. Hudda Schenectady, N.Y., The Knolls, Res. Inform. Section, Mar. 1962 32 p 18 refs

(Supported by AFOSR)

(Rept. 62-RL-2966-M)

The utility of the field ion microscope for adsorption studies has been explored by examining the interaction of nitrogen with an atomically smooth tungsten surface. Individual nitrogen adatoms are shown to be visible, and it is demonstrated that adsorption fails to perturb the lattice permanently. In probing the room-temperature distribution of adsorbed material, the closely packed (110) is found to remain bare, even when exposed to nitrogen at $p = 2 \times 10^{-6}$ mm for 2 hours. All the other planes, with the possible exception of the {100} and {130}, are irreversibly covered. Nitrogen, presumably in the form of atoms, is bound on the (110) only at T < 190° K. Adsorption on this plane at higher temperatures is limited not by an activation barrier but rather by thermodynamics: the binding energy on the (110) is only 5.1 ev, compared with 6.7 ev elsewhere on the surface. Author

24 PHYSICS, PLASMA

Includes: fusion; and magnetohydrodynamics.

For related information see: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N63-15268 California U., Berkeley
INTRODUCTION TO RECOMBINATION IN PLASMAS Technical Report No. 5
A. E. Glassgold Jan. 1, 1963 36 p 17 refs
(Contract Nonr 222(70); Proj. Defender)

The atomic processes important in plasma recombination are reviewed. Dilute, monatomic gases which are not in any external fields are discussed, and numerical estimates are made only for the hydrogenic plasma of astrophysical interest. By so limiting the discussion, a problem amenable to theoretical treatment is obtained. The material is divided into three parts dealing with radiative recombination, three-body recombination, and a short description of the physical processes in a moderately dense plasma. D.E.R.

N63-15329 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-Sous-Bagneux
MESURE OPTIQUE DES TEMPÉRATURES ÉLEVÉES [OPTICAL MEASUREMENT OF HIGH TEMPERATURES]
Lionel Nadaud and Monique Gicquel [1962] 32 p 14 refs In French Presented at the AGARD Specialists' Meeting on High Temperature Aspects of Hypersonic Flow, Rhode-St.-Genèse, Belgium, Apr. 2, 1962

A review of optical measurement of high temperatures includes: (1) a brief discussion of the ONERA (National Office of Aeronautical Studies and Research) method of measuring flame temperatures which do not exceed 3000° K, which method is based on the principle of spectral ray inversion; (2) a recording of the ignition temperature of a mixture of air and hydrocarbon, which ignition was caused by a shock wave, and a discussion of the accuracy of the measurement; (3) the use of a standard of brilliance for 5000° K, that permits the extension of the ONERA method to include temperatures in the 10,000° K range. This temperature (10,000° K) was reached in an arc-blown plasma. A description of the apparatus used for measuring this temperature is presented. Trans. by I.v.L.

N63-15331 France. Office National d'Études et de Recherches Aéronautiques, Chatillon-Sous-Bagneux
AMELIORATION D'UNE SOUFFLERIE A ARC BREF PAR LA RÉALISATION D'UN ARC TOURNANT DANS LA CHAMBRE HAUTE PRESSION [IMPROVEMENT OF A SHORT ARC WIND TUNNEL BY USING A REVOLVING ARC IN THE HIGH PRESSURE CHAMBER]
M. Delattre [1962] 21 p In French Presented at the AGARD Specialists' Meeting on High Temperature Aspects of Hypersonic Flow, Rhode-St.-Genèse, Belgium, Apr. 3–6, 1962

Experiments utilizing a revolving arc in the ONERA short arc-wind tunnel are reported. It is found that greater homogeneity of temperatures and lower wave pollution levels are produced using this apparatus, and the tension on the arc is more easily regulated than with a fixed arc. D.E.R.

N63-15379 Avco-Everett Research Lab., Everett, Mass.
MHD GENERATOR PERFORMANCE UNDER NON-UNIFORM AND TIME VARYING LOAD
J. F. Louis and R. Decher Mar. 1963 24 p 3 refs
(Supported jointly by Avco Corp. and American Electric Power Service Corp.)
(Avco-Everett Res. Rept. -148)

An MHD generator with segmented electrodes is idealized as a one-dimensional channel with infinite segmenting. Transient and steady-state effects due to local nonuniformities on the remainder of the channel are investigated. Author

N63-15384 Comitato Nazionale per l'Energia Nucleare. Lab. Nazionali, Frascati (Italy)
EFFECTS OF VIRTUAL VECTOR MESONS IN e^+e^- COLLISIONS
R. Gatto Feb. 12, 1962 13 p 8 refs Submitted for Publication (*Its* Nota interna 184; LNF-63/6)

An investigation of the vacuum polarization effects due to virtual vector mesons in high-energy electron–positron collisions is made. Comment is also made on the resonance contributions arising from production and decay of vector mesons in such collisions. For energies near the meson mass, the vacuum polarization effects modify the cross-section formula by a factor E, which is derived mathematically. The most apparent effect of vector mesons in electron-positron collisions is the occurrence of resonance peaks in annihilation processes and direction of the resulting e^+e^- pair into final channels of strong coupling to the mesons. Other results are only approximate because of the lack of knowledge of the gamma and beta parameters of the vector mesons at present. D.E.R.

N63-15406 Armament Research and Development Establishment, Fort Halstead, Sevenoaks (Gt. Brit.)
LANGMUIR PROBE AND VELOCITY MEASUREMENTS IN THE ARDE PLASMA JET
W. A. Clayden [1962] 35 p 13 refs AGARD Specialist's Meeting on High Temperature Aspects of Hypersonic Flow, Rhode St. Genèse, Belgium Apr. 3–6, 1962

Two techniques have recently been developed for the ARDE plasma jet to measure (a) the velocity and (b) the electron density and temperature of the ionized stream. The velocity has been obtained from measurements of the potential produced by a magnetic field normal to the direction of flow of the ionized gases, and a typical velocity is 10^5 cm/sec. The effects of the degree of ionization, shape of probes and the eddy currents on the velocity measurements are discussed. A simple theory is given for the interpretation of results from a Langmuir probe operating in a hypersonic plasma flow when the mean free path of the neutral particles is larger and the Debye length smaller than a typical probe dimension; typical measurements give an electron density of 10^{13} electrons/cm^3 and a temperature of 2,000° K. Author

N63-15423 Nagoya U. Inst. of Plasma Physics (Japan)
MOTION OF ELECTRONS IN A MAGNETIC BOTTLE
Shuji Fukui, SatioHayakawa, Tadao Honzawa, Hiroyuki Nishimura, and Haruo Obayashi Dec. 1962 42 p 13 refs
(Rept. IPPJ-2)

In order to investigate the motion of electrons as single particles, a magnetic bottle has been constructed into which electrons are injected by a electron gun. Although the shadow effect of the gun was considerably large, a fraction of electrons not colliding with the gun system could be distinguished from those which collided, by the method of pulsed injection. The shadow effect was further eliminated by varying the pressure of a gas (He or A) in the chamber. The trapping time of injected electrons was deduced essentially from the intensity of slow electrons produced by their collisions with gas atoms, and it was found to be accounted for in terms of the single Coulomb scattering. The lifetime of the slow electrons can be qualitatively explained by their atomic scattering. Author

N63-15469 Nagoya U. Inst. of Plasma Physics (Japan)
Annual Review, Apr. 1961–Mar. 1963 [STUDY OF PLASMA PHYSICS AND CONTROLLED THERMONUCLEAR FUSION]
Shigeo Nagao et al Mar. 31, 1963 53 p 10 refs

The Institute of Plasma Physics intends to prepare a completely ionized plasma in a steady state. To achieve this goal, neutral particles from a dense discharge plasma in a magnetic field will be preferentially eliminated. J.A.J.

N63-15472 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A THEORETICAL STUDY OF THE MOTION OF AN IDEALIZED PLASMA RING THROUGH VARIOUS TRAVELING-MAGNETIC-WAVE PLASMA ACCELERATORS
Clarence W. Matthews Washington, NASA, May 1963 22 p 6 refs
(NASA TN D-1636) OTS: $0.75

The results of several computations of the motion of idealized plasma rings, under the influence of several different traveling-magnetic-wave accelerators, are presented and analyzed to show some of the theoretical phenomena that can occur in such accelerators. The results indicated that only a narrow range of magnetic-field and plasma-ring characteristics existed in which the plasma ring was confined within the accelerator. Slippage of the ring with respect to the field was observed in all the computations made. Comparison with available experimental data showed almost an order-of-magnitude reduction in velocity resulted from experimental effects. Author

N63-15476 Princeton U. Plasma Physics Lab., N.J.
DECREASE OF PLASMA LOSS IN A STELLARATOR RESULTING FROM A PROBE-IMPOSED RADIAL ELECTRIC FIELD
J. G. Gorman and L. H. Th. Rietjens Feb. 1963 19 p 6 refs
(Contract AT(30-1)-1238)
(MATT-157)

Current-voltage characteristics of simple, wire-type Langmuir probes have been obtained as a function of position and time in the nearly fully-ionized hydrogen plasmas of the B-3 stellarator. The magnetic confining field ranged up to 38 kg, the plasma density to 2×10^{13} per cc, and the conductivity temperature to 5 ev. Well-defined saturation current densities are found for both ions and electrons in the ratio of about 1 to 30. The probe data yield electron temperatures proportional to the conductivity temperatures and plasma densities proportional to the microwave-determined densities. If a sufficiently large electron current is collected by a probe, a radial electric field as high as 300 v/cm can be induced in the plasma. The experimental data suggest that a plasma capacitor is established having a magnetic surface as the inner plate, the discharge tube as the outer plate, and the plasma as a dielectric. For this potential distribution, a diffusion coefficient $D = 1.3 \pm 0.3 \times 10^3$ cm^2/sec has been found for the outer region for a 4 ev plasma in a 38 kg confining field. Both computations and experiments show that a twofold increase in the confinement time of the plasma can be obtained by enlarging the outer region in which the radial electric field is established. Author

N63-15477 Princeton U. Plasma Physics Lab, N.J.
CESIUM PLASMA EXPERIMENTS
Nathan Rynn Dec. 1962 29 p 5 refs Presented at the 3rd Annual Conf. on the Engineering Aspects of Magnetohydrodynamics, Rochester U., Mar. 29, 1962
(Contract AT(30-1)-1238)
(MATT-168)

The Q-machine, a plasma cesium device, is described and the program of study with this device is discussed. The operating principle of the machine is based on the thermal-ionization of cesium on a hot tungsten surface. A beam of cesium atoms strikes the hot (2000° to 2800° K) tungsten plate, and the mixture of tungsten electrons and cesium ions form a plasma that is confined in the radial direction by a strong magnetic field surrounding the vacuum vessel. Studies on plasma stability are described along with studies on the diffusion rate after the onset of instabilities. Possible experimental programs are outlined. R.C.M.

N63-15478 Princeton U. Plasma Physics Lab., N. J.
EFFECT OF RESISTIVITY ON HYDROMAGNETIC INSTABILITIES IN MULTIPOLAR SYSTEMS
John L. Johnson, John M. Greene, and Bruno Coppi Feb. 14, 1963 64 p 15 refs
(Contract AT(30-1)-1238)
(MATT-170)

The effect of electrical resistivity hydromagnetic instabilities is studied with special emphasis on interchange instabilities. A "stellarator" expansion is utilized to reduce the stability problem to one of solving two coupled second-order ordinary differential equations. Further expansions are made in which perturbations vary rapidly in a thin layer the width of which is related to the resistivity. Highly localized interchange instabilities are found with growth rates which are independent of the resistivity in the limit as it goes to zero. These exist whenever the pressure decreases outwards. Interchanges with eddies of finite length grow more slowly, as the cube root of the resistivity. A stability criterion for kink modes, which are characterized by vanishing pressure gradients in the resistive layer, is obtained. It depends on the entire plasma configuration, and is identical to the one that would be obtained from the energy principle if the resistive layer were replaced with a vacuum. Author

N63-15488 California U., Berkeley. Lawrence Radiation Lab.
DESIGN OF A DIFFERENTIAL CALORIMETER SUITABLE FOR MEASUREMENT OF HIGH TEMPERATURE HEATS OF SOLID STATE REACTIONS
John O. Barner (M. S. Thesis) Jan. 29, 1963 52 p 7 refs
(Contract W-7405-eng-48)
(UCRL-10631) OTS: $1.25

A differential calorimeter suitable for measurement of high-temperature heats of solid-state transformations was designed and tested. The heats of transformation of SiO_2, K_2SO_4, Na_2SO_4-III, and FeS were measured and were found to be in general agreement with published values. Increase in heat-content measurements were found to be 30% to 40% high due to unequal vertical heat losses from the two sample cells of the differential calorimeter. Author

N63-15501 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DIRECT VELOCITY MEASUREMENTS IN LOW-DENSITY PLASMA FLOWS
W. D. Beasley, J. D. Brooks, and R. L. Barger Washington, NASA, May 1963 12 p 5 refs
(NASA TN D-1783) OTS: $0.50

The flow velocity is measured directly in a direct current arc jet by creating a luminous disturbance in the flow and measuring its time of flight over a known distance with photoelectric detectors. This technique is applicable to flows with high stagnation temperatures and low discharge pressures. Measurements made in supersonic flows without arc heating correlated well with velocities computed from pressure probe measurements. Measurements made in supersonic plasma flows exhibited good repeatability at static pressures well below 1 mm Hg. Author

N63-15503 Nagoya U. Inst. of Plasma Physics, (Japan)
CANONICAL FORMALISM OF THE MOTION OF A CHARGED PARTICLE IN A MAGNETIC FIELD Research Report
Satio Hayakawa and Haruo Obayashi Feb. 1963 59 p 28 refs
(IPPJ-5)

The motion of a charged particle in a static magnetic field with axial symmetry is formulated by introducing a set of canonical variables; thus ambiguities in intuitive theory are avoided. It is shown that it is possible to choose these variables for describing three modes of motion: the gyration about a line of force, the drift along the line of force, and the azimuthal drift about the symmetry axis. The Hamiltonian expressed in terms of these variables is expanded in power of a small parameter that is of the same order of magnitude as the ratios of the gyration radius to the

of curvature of a line of force and of a magnetic equipotential line and also to the distance from the axis. The zeroth order Hamiltonian thus obtained describes the motion in the first-order orbit theory, whereby the magnetic moment is taken as equal to the action variable of the gyration mode at a line of force at which the kinetic angular momentum vanishes. The mirror point migration is obtained in a higher order approximation. This effect results, when applied to geomagnetically trapped particles, in the increase of the thickness of matter traversed by the particles, because of a steep altitude dependence of air density, and may be responsible for the absence of high-energy protons in the outer radiation belt. Through this application it is illustrated that the present method provides a good approximation in the case of large γ, where γ is Stormer's constant of integral proportional to the angular momentum about the symmetry axis. Author

N63-15661 Nagoya U. Inst. of Plasma Physics (Japan)
LANGMUIR PROBE METHOD FOR A PLASMA HAVING SMALL AMPLITUDE OSCILLATIONS Research Report
Minoru Sugawara and Yoshisuke Hatta (Tohoku U.) Feb. 1963 23 p 6 refs
(IPPJ-4)

Langmuir probe characteristics for a plasma having oscillations of space potential, electron density, and electron temperature are discussed in detail. The method of deriving amplitudes of oscillation as well as values of the d.c. component are introduced. In order to get information about oscillating components, the "method of constant current probe" developed by Barnes and Eros is applied with some extension. Author

N63-15672 California U., Berkeley. Electronics Research Lab.
BEHAVIOR OF THE SPACE CHARGE IN A PLASMA MAGNETRON
Y. Ikeda June 15, 1962 46 p 12 refs
(Contract AF 19(628)-324)
(Sci. Rept. No. 17; IER Ser. No. 60, Issue No. 433, AFCRL-63-41) OTS: $1.25

An analytical and experimental investigation of "plasma" magnetrons with smooth-bore anodes is described. Secondary-emission yield of several materials is investigated, and the region in which limiting anode currents are obtained is related to the operation of conventional magnetrons. Basic phenomena caused by Philips-ion-gage discharge particles are described, with particular emphasis on the sheath region. The phenomena underlying the buildup of anode current are elucidated. Author

N63-15676 California U., Berkeley. Electronics Research Lab.
POSITIVE-COLUMN STRIATIONS IN GASEOUS CONDUCTORS [Interim Report]
B. E. Dobratz June 19, 1962 31 p 11 refs
(Contract AF 19(628)-324)
(Sci. Rept.-19; IER Ser. 60, Issue 454; AFCRL-63-25) OTS: $1.25

The positive column in certain gaseous conductors was examined by external electrostatic probe pickup, by photoelectric signal pickup, and by rotating mirror images for time-periodic oscillations and space-periodic striations. Mercury vapor with d.c. excitation gave moving positive striations (motion away from anode) of large amplitude with a velocity of about 50 meters per second. No direct observational evidence of negative striations was found, contrary to what has been reported by some authors, but there was some indirect evidence of weak negative striations. No stationary striation pattern was found in mercury vapor with d.c. excitation. Mercury vapor with a.c. excitation gave pronounced stationary striations, which were found to be the optical result of cyclic motion of a sequence of moving positive striations. Ultrapure hydrogen and helium were examined. No oscillation or striation phenomena were found in these gases with the exception of a pronounced stationary striation pattern in ultrapure hydrogen under d.c. excitation. Author

N63-15685 Chalmers U. of Tech. Research Lab. of Electronics, Goteborg (Sweden)
DYNAMIC NON-LINEAR WAVE PROPAGATION IN IONIZED MEDIA. 8. REFLECTION OF ELECTROMAGNETIC WAVES FROM A DIELECTRIC, PLANE LAYER, VARYING PERIODICALLY IN SPACE AND TIME
A. R. Thomasson 1962 37 p 4 refs
(Contract AF 61(052)-451)
(US-33; AFCRL-63-82)

The purpose of the investigation is to study the interaction between an obliquely incident, plane electromagnetic wave and a plane, semi-infinite dielectric medium, the dielectric constant of which contains a space- and time-varying component. The problem of the possible creating of such a forced variation, or disturbance, lies outside the scope of this report. First considered is a medium, the dielectric constant of which is periodically fluctuating only in time. It can then be shown that one gets parametric resonance when the angular frequency, ω_1, of the incident electromagnetic wave is equal to half the angular frequency, ω_2, of the forced, or pumped, variations in the disturbed medium. However, when the disturbance is propagating, this resonance condition becomes altered. It is found that, in order to get resonance effects, certain relations depending on the angle of incidence and the phase velocities of the incident and "pump"-wave, predicted by Rydbeck, must be fulfilled. The harmonic time variation of the dielectric medium produces transmitted and reflected waves ("non-linear" modes) on the characteristic frequencies $\omega_1 \pm n\,\omega_2$, where $n = 0, 1, 2 \ldots$ The angles of reflection and transmission will be functions of the propagation parameters of the two waves as expressed by a generalization of Snellius's law. The investigation also includes the case where losses are taken into account. Author

N63-15741 Pennsylvania State U. Ionosphere Research Lab., University Park
DYNAMIC NON-LINEAR ELECTROMAGNETIC WAVE PROPAGATION AND HARMONIC RADIATION IN MAGNETO-IONIC MEDIA
O. E. H. Rydbeck June 1, 1963 42 p 3 refs
(Contract AF 19(604)-4563 and NSF Grant G-18983)
(Sci. Rept. 186; AFCRL-63-448)

The nonlinear propagation of electromagnetic waves is extended to a magneto-ionic medium with the limitation that all wave normals are parallel. It is shown that traveling wave resonances occur in the medium, not only between waves of the same kind but also between waves of opposite kinds. One also finds that the second-order nonlinear waves are characterized by two kinds of polarization equal only at traveling wave resonance. The postulate that traveling wave resonances are efficient in the "topside" ionosphere with a small electron density gradient is investigated, along with echo generation (2nd harmonics), higher harmonics, and parametric amplification of echos. D.E.R.

25 PHYSICS, SOLID-STATE

Includes: semiconductor theory; and masers.

For related information see: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N63-15289 Radio Corp. of America. RCA Labs., Princeton, N.J.
INVESTIGATIONS OF FUNDAMENTAL LIMITATIONS DETERMINING THE ULTIMATE SIZE OF MICROSTRUCTURES Special Scientific Report No. 2
J. T. Wallmark David Sarnoff Research Center, Dec. 31, 1962 21 p 9 refs
(Contract AF 19(604)-8040)
(AFCRL-63-12)

The minimum size and maximum packing density reported earlier for semiconductor devices is extended to solid-state devices in general; i.e., active devices, such as magnetic, superconductive, and dielectric devices, as well as passive devices, such as resistors, capacitors, and inductors. The minimum size is 3 microns on a side, and in a circuit the minimum space per component is about 6 microns on a side, corresponding to a maximum packing density of about $5 \cdot 10^9$ components/cm^3 ($7 \cdot 10^{10}$ components/in^3). The chief limiting physical phenomenon is the edge definition in fabrication of devices. For super conductive devices, the cooling equipment is a major limiting factor to high packing density. Author

N63-15336 Microwave Associates, Inc., Burlington, Mass.
APPLICATION OF SEMICONDUCTOR DEVICES TO HIGH POWER DUPLEXERS Third Quarterly Progress Report, 1 Aug. 1962 to 31 Oct. 1962
Joseph White Feb. 7, 1963 15 p
(Contract AF 30(602)-2656)
(RADC-TDR-63-88)

The program for this quarter had the following aspects: (1) the building of packaged PIN diodes to meet the design criteria set forth in the last quarter; (2) the design and building of an integrated semiconductor-duplexer structure to maximize the heat dissipation and power-handling capabilities of the structure; (3) design of the semiconductor junction to minimize the thermal dissipation, the turn-on time, and the series resistances. Author

N63-15413 California U., Berkeley. Electronics Research Lab.
PHOTODISSOCIATION OF MOLECULES FOR EXCITATION OF AN OPTICAL MASER
J. R. Singer Jan. 8, 1962 10 p 6 refs
(Contract AF 49(638)-102)
(IER Ser. 60, Issue 429; AFOSR-2251)

A technique is proposed for the elimination of Doppler broadening in optical masers by observing atomic transitions perpendicular to the path of an atomic beam. The general plan is to photodissociate the molecules within an optically resonant structure, and have the excited atoms decay with the emission of coherent light because of the positive regeneration of the structure. Atom and ion emission data are summarized for materials which are candidates for a molecular-beam optical maser.

N63-15439 Avco Corp. Research and Advanced Development Div., Wilmington, Mass.
RESEARCH ON AEROSOL SCATTERING IN THE INFRARED. ATLAS OF SCATTERING DIAGRAMS FOR n = 1.5 Scientific Report 10
Rudolf B. Penndorf Nov. 1962 52 p 9 refs
(Contract Af 19(604)-5743)
(RAD-TR-63-9; AFCRL-62-1131)

Angular scattering diagrams are constructed for spherical aerosols of refractive index n = 1.5. They show the intensity functions i_1, i_2, and $i_1 + i_2$ as functions of the scattering angles for size parameter $\alpha = 0.5\ (0.5)\ 10$. The basic data have been computed using Mie's theory, and a graphical interpolation technique (altitude-chart technique) has been used to determine accurately the position and numerical value of the maxima and minima. Author

N63-15453 Massachusetts Inst. of Tech., Cambridge
ISOTOPE SHIFT AND SATURATION BEHAVIOR OF THE 1.5 μ TRANSITION OF Ne
A. Szoke (Weizman Inst.) and A. Javan Apr. 26, 1963 10 p 7 refs
Submitted for Publications
(NASA Grant NsG-330)
OTS: $1.10 ph, $0.80 mf

An experiment conducted with a helium-neon optical maser is summarized; the isotope effect, together with the saturation behavior of one of the Doppler-broadened optical transitions of Neon at 1.15 μ, is studied. A study of the maser's power dip when it is in a standing optical field gives information on the saturation behavior and the relaxation processes of the active atoms. The reproduction of the maser's optimum frequency then gives the index of the isotope effect and data on the saturation behavior. D.E.R.

N63-15457 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
ENERGIES OF TWO INTERSTITIAL CONFIGURATIONS IN A FACE-CENTERED CUBIC CRYSTAL
P. Hoekstra and D. R. Behrendt Repr. from Phys. Rev., v. 128, no. 2, Oct. 15, 1962 p 560-561 Previously announced as a preprint See N63-12554 08-21

The energies of formation for two configurations of an interstitial in a face-centered cubic crystal were calculated. One interstitial was in the body-centered position and the other is formed by two atoms sharing, and slightly displaced from, a normal face-center site. A Morse potential function for copper was used for the interaction between the atoms. The results of this calculation indicate that the energies of formation differ by a small fraction of an electron volt. Author

N63-15544 United Nuclear Corp. Development Div., White Plains, N.Y.
NEUTRON CROSS SECTIONS FOR BERYLLIUM Final Report, 20 Mar. 1961-31 May 1962
A. D. Krumbein Army Chemical Center, Md., Nuclear Defense Lab. May 1962 27 p 10 refs
(Contract DA-18-108-405-CML-1007)
(UNC-5014, Vol. B; NDL-TR-36)

Neutron cross sections for energies up to 18 mev are given for beryllium. Author

N63-15568 Comitato Nazionale per l'Energia Nucleare. Lab. Nazionali, Frascati (Italy)
CALCOLI DI SEZIONI D'URTO PER PRODUZIONE DI COPPIE DA FOTONI LINEARMENTE POLARIZZATI, IN CRISTALLI [CALCULATIONS OF THE COLLISION SECTION FOR PRODUCING LINEARLY POLARIZED PHOTON PAIRS IN CRYSTALS]
G. Barbiellini and G. Bologna Dec. 20, 1962 18 p 5 refs
In Italian
(*Its* Nota Interna 113; Lnf-62/113)

Methods of measuring linear polarization of a high-energy photon beam (gev) are discussed. This paper describes a new method for obtaining these measurements in which the results are in good agreement with those obtained with other known methods. Trans. by P.F.E.

N63-15614 California U., Berkeley. Lawrence Radiation Lab.
STUDY OF THE NUCLEAR ZEEMAN EFFECT IN Au^{197}
Ronald W. Grant Jan. 29, 1963 85 p 48 refs
(UCRL-10649) OTS: $2.00

Mössbauer experiments have been performed in external magnetic fields up to 86 kg with Pt^{197} dissolved in Fe, Co, and Ni sources, and Au absorbers. The magnetic moment of the 77-Kev isomeric state of Au^{197} was measured as $\mu = +0.37 \pm 0.05$ nm. The hyperfine fields at Au nuclei dissolved in Fe, hex. Co, cubic Co, and Ni were found to be -1420 ± 220, -980 ± 150, -990 ± 150 and -340 ± 70 kg, respectively. The magnitude of the hyperfine field was found to be nearly proportional to the effective atomic magnetic moment of the host ferromagnetic material. Experiments were performed in an external magnetic field with sources of Pt^{197} dissolved in Be and Pt in an attempt to measure μ directly; however, complicated behavior was observed which is explicable

in terms of mixed magnetic dipole and electric quadrupole interactions. The effect of magnetostriction has been observed in ferromagnetic sources which makes sign determinations of internal fields in ferromagnets, using the Mössbauer effect, less straightforward than is usually assumed. Author

N63-15659 Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.
MICROWAVE PHONON GENERATION BY THIN MAGNETIC FILMS
Marden H. Seavey, Jr. Feb. 1963 26 p 12 refs
(AFCRL-63-57)

The magnetostrictive generation of microwave phonons by thin magnetic films is theoretically described, and experimental data taken at X-band are discussed. The cases of generation on the uniform precession on ferromagnetic resonance (FMR) and on spin-wave resonance (SPWR) are treated. Wave equations are obtained for the displacement components when the d.c. magnetic field makes an arbitrary angle with the film normal. These have driving terms proportional to dm/dy which are responsible for the phonon generation. It is shown that in the FMR case, the generation occurs at the film surfaces, while in the SPWR case, the generation take place throughout the film interior. The experimental data appear to support the generation model in the FMR case, but unexplained discrepancies exist between theory and experiment in the SPWR case. A comparison with quartz piezoelectric generation is made, and while the generation efficiencies are about equal, substantial improvement is possible in the magnetostrictive case. Author

N63-15700 Joint Publications Research Service, Washington, D.C.
THE CRYSTAL IS SMALL BUT POWERFUL
A. Trutko and Ya. Fedotov Jan. 29, 1963 7 p Transl. of an article from Izv. (Moscow), Dec. 7, 1962 p 4
(JPRS-17351) OTS: $0.50

The technological processes for producing semiconductor devices are reviewed. The basic materials of semiconductors are silicon and germanium which require purification, alloying, and machining. Improvements in the technical processing of semiconductors are given. N.E.A.

N63-15714 Microwave Associates, Inc., Burlington, Mass.
NANOSECOND PULSE BREAKDOWN STUDY Final Report
C. Buntschuh, B. Salkins, and M. Gilden Feb. 21, 1963 59 p 17 refs
(Contract AF 30(602)-2782)
(RADC-TDR-63-82)

An estimate is made of the pulse-breakdown characteristic for air on the basis of the theory worked out by Gould and Roberts and the available data. The theory is critically examined and the consequences of the assumptions made are investigated to insure its applicability to extremely short pulse breakdown. Several possible modifications are advanced which require experimental verification with nanosecond pulse lenghts. The possible advantages of using so-called high dielectric strength gas is also discussed. Progress on development of a nanosecond pulse-generation circuit is reported; several ATR switches are described and discussed. Author

N63-15745 Illinois U. Coordinated Science Lab., Urbana
A STUDY OF THE EJECTION OF ELECTRONS FROM THE SURFACE OF TUNGSTEN BY LOW ENERGY IONS
Franklin M. Propst Feb. 1963 123 p 76 refs
(Contract DA-36-039-SC-85122)
(R-161)

Included in this review are: (1) yields and energy distributions of electrons ejected from clean tungsten by positive ions of helium, hydrogen, nitrogen, and oxygen and (2) the effect of adsorbed gases on the yields and energy distribution of electrons ejected from tungsten by low energy ions encompassing the following cases: electrons ejected by hydrogen ions due to the adsorption of hydrogen, electrons ejected by nitrogen ions due to the adsorption of nitrogen and electrons ejected from hydrogen- and nitrogen-covered tungsten by helium ions. I.v.L.

N63-15747 Princeton U. Plasma Physics Lab., N.J.
MILLIMETER SINGLE-SIDE-BAND GENERATORS
W. P. Ernst and A. Skislak Feb. 1963 21 p 4 refs
(Contract AT(30-1)-1238)
(MATT-167)

A simple scheme consisting of two crystal modulators, a hybrid ring or "rat race," and an adjustable phase shifter is used to produce a single side-band suppressed carrier signal. Specifically, 35-gc and 70-gc systems have been constructed and tested. Carrier and unwanted side-band suppression exceed 20 db. Either side-band may be selected by simply changing the phase of one modulation input by 180°. Author

26 PROPELLANTS AND COMBUSTION

Includes: fuels; igniters; and oxidizers.

For related information see: 07 Chemistry; and 27 Propulsion.

N63-15300 Space Technology Labs., Inc., Redondo Beach, Calif.
GAS PARTICLE NOZZLE FLOWS
James R. Kliegel [1962] 66 p 32 refs Presented at the 9th International Combustion Symposium, Cornell U., Ithaca, N.Y., Aug. 1962
(Contract AF 04(694)-1)

The equations governing the one-dimensional flow of gas-particle mixtures are derived and discussed. It is shown that the sound velocity in the mixture is the frozen sound velocity in the gas alone and in unaffected by the presence of the particles unless the mixture is always in equilibrium. The equilibrium sound velocity in the mixture is derived and is shown to be lower than the frozen sound velocity. Shock waves in gas-particle mixtures are discussed and it is shown that two shock structures are possible. When the flow velocity in front of the shock is supersonic (based on the frozen speed of sound), the shock consists of a discontinuous shock front followed by a relaxation zone. When the flow velocity in front of the shock is greater than the equilibrium sound speed but less than the frozen sound speed, the shock is fully diffuse and consists of a relaxation zone in which both the gas and particle properties vary continuously. A sample nozzle calculation is given and compared with one-dimensional calculations. A comparison of the calculated and experimentally measured nozzle performance is given for many nozzles. It is found that the calculations and experiments are in agreement within the accuracy of the experimental measurements. It is concluded that the flow of gas-particle mixtures can be accurately predicted by the present analysis. Author

N63-15389 General Dynamics/Astronautics. Space Science Labs., San Diego, Calif.
HIGH TEMPERATURE EMISSIVITIES OF THE 2.7 MICRON BAND OF H_2O BETWEEN 1000°K AND 2200°K Technical Report
Carmine C. Ferriso and Claus B. Ludwig Apr. 1963 48 p 9 refs
(Contract Nonr-3902(00); Proj. Defender)
(BBE63-002)

Spectral emissivities between 2800 cm^{-1} and 4200 cm^{-1} have been obtained for water vapor at 1000°, 1200°, 1500°, 1800° and 2200° K. The heated H_2O test gas was produced at the

exit of a small rocket burner which used H_2 and O_2 propellants. The emission measurements of the gases were made at the immediate exit of the burner where the composition, total pressures, and temperature can be defined. The emissivities or absorptivities were calculated from a calibrated emission spectrum and an accurate spectroscopic determination of the temperature of the test gas. The composition of H_2O was evaluated from a semiempirical fit to a thermochemical flow calculation. The hot H_2O samples were observed at a total pressure of one atmosphere in the optically thin region where the spectral emissivities are, on the average, approximately 0.05. The variation of the spectral emissivities of H_2O in the 2.7-micron region as a function of temperature are given for a constant amount of H_2O in the optical path. A good estimate of the integrated intensity of the 2.7 micron H_2O band (ν_1 and ν_3) has been made from the high-temperature data. Author

N63-15407 Guggenheim Labs. for the Aerospace Propulsion Sciences, Princeton U., N.J.

ENTROPY WAVES GENERATED BY COMBUSTION UNDER OSCILLATORY PRESSURE

R. H. W. Waesche, J. Wenograd, and M. Summerfield [1963] 12 p 4 refs Presented at 3rd Meeting of the Combustion Instability Panel, Johns Hopkins U., Md., Mar. 4–5, 1963

A program to investigate the physicochemical aspects of combustion instability is summarized. The study was done through the observation of the interaction between the solid-propellant flame zone and an oscillating pressure field, with particular attention paid to the nature of the boundary conditions of the flame zone-pressure field. The quantitative measurements of the temperature and phase relations given an indication of the validity of the isothermal boundary condition and the mechanism of combustion in an oscillating pressure field. Entropy wave zones have been shown to exist for nonmetallized composite propellants. D.E.R.

N63-15429 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

THE APPLICATION OF SHORT-DURATION TECHNIQUES TO THE EXPERIMENTAL STUDY OF BASE HEATING. PART I: HIGH-ALTITUDE TESTING TECHNIQUE AND EXPERIMENTAL RESULTS FOR A 4-ENGINE ROCKET CONFIGURATION

K. D. Bird, C. L. Matthis, and J. W. Reece Apr. 1962 67 p 19 refs (NASA Contract NAS8-823)
(CAL HM-1510-Y-1(I))

A new experimental approach to the study of base heating of rocket vehicles is described, and data obtained by means of this technique are presented. Short-duration techniques similar to those employed in shock tubes are used to duplicate the composition, pressure, and temperature of rocket-engine exhausts. Flow durations are sufficient to permit the establishment of base flows but are short enough to obviate the usual combinations of engineering problems associated with conventional hot-flow models. Heat-transfer and pressure instrumentation developed for shock tunnels is shown to be ideally suited for base-heating studies. Investigations have been carried out on a model of a 4-engine cluster nozzle configuration at altitudes ranging from 125,000 feet to 250,000 feet. Throughout this range, a portion of the exhaust flow is recirculated into the base region, and the altitude at which choking of this recirculated flow occurs between the nozzle bases is covered. Measurements of heat-transfer rate and static pressure were made on the base plate of the model in order to determine the effect of this recirculated exhaust flow. Author

N63-15576 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.

TECHNICAL PANEL ON SOLID PROPELLANT COMBUSTION INSTABILITY Unclassified Proceedings of the Second Meeting, Stanford Research Inst., Menlo Park, Calif., Mar. 8-9, 1962 May 1962 146 p 16 refs

(Contract NOw 62-0604-C)
(TG 371-4B)

CONTENTS:

1. COMBUSTION INSTABILITY IN SOLID FUEL ROCKETS—ANATOMY 1962 F. T. Mc Clure (Applied Physics Lab.) p 1–10 (See N63-15577 12-26)
2. MEASUREMENTS OF OSCILLATORY BURNING M. D. Horton (Naval Ord. Test Station) p 11–12 (See N63-15578 12-26)
3. SPECIFIC ACOUSTIC ADMITTANCE MEASUREMENTS OF BURNING SOLID PROPELLANT SURFACES BY A RESONANT TUBE TECHNIQUE Richard Strittmatter, Leland Watermeier, and Samuel Pfaff (Aberdeen Proving Ground) p 13–20 2 refs (See N63-15579 12-26)
4. ACOUSTIC ADMITTANCE MEASUREMENTS ON BURNING PROPELLANTS D. W. Blair (Aerochem Research Labs.) p 21–23 (See N63-15580 12-26)
5. MEASUREMENT OF THE SURFACE IMPEDANCE OF BURNING SOLID PROPELLANTS A. O. Converse (Carnegie Inst. of Tech.) and E. S. Stern (Thiokol Chemical Corp.) p 24–26 (See N63-15581 12-26)
6. EXPERIMENTAL STUDIES OF SOLID PROPELLANT COMBUSTION INSTABILITY T. A. Angelus (Allegany Ballistics Lab.) p 26a (See N63-15582 12-26)
7. ACOUSTIC ADMITTANCE OF BURNING SOLID PROPELLANT SURFACE G. M. Muller and G. A. Agoston (Stanford Research Inst.) p 27–31 (See N63-15583 12-26)
8. EVALUATION OF A TRANSIENT METHOD FOR MEASURING ACOUSTIC IMPEDANCE R. B. Lawhead (Rocketdyne) p 32–34 (See N63-15584 12-26)
9. PROGRAM FOR MEASURING THE SCATTERING OF SOUND BY GASEOUS FLAMES H. M. Wight (Aeronutronic Research Labs.) p 35–39 (See N63-15585 12-26)
10. STABILITY GRADING OF SOLID PROPELLANTS BY THE OSCILLATORY STRAND BURNER TEST J. Diederichsen (Rocket Propulsion Estab., (Gt. Brit.)) p 40–42 (See N63-15586 12-26)
11. ABSTRACT OF REPORT TO SECOND SPIC TECHNICAL PANEL MEETING; NOTS RESEARCH ON LOW FREQUENCY COMBUSTION INSTABILITY E. W. Price (Naval Ord. Test Station) p 43–50 (See N63-15587 12-26)
12. SOME EXPERIMENTAL OBSERVATIONS OF ALUMINUM BURNING IN SOLID ROCKET PROPELLANTS Leland Watermeier, William Aungst, and Samuel Pfaff (Aberdeen Proving Ground) p 51–58 (See N63-15588 12-26)
13. CARDE INVESTIGATIONS OF FINITE WAVE AXIAL COMBUSTION INSTABILITY L. A. Dickinson (Canadian Armament Res. and Development Estab.) p 59–66 3 refs (See N63-15589 12-26)
14. ON ACOUSTIC AMPLIFICATION AND ATTENUATION BY BURNING SOLID PROPELLANTS R. W. Hart (Applied Physics Lab.) p 67–71 (See N63-15590 12-26)
15. ANALYTICAL INVESTIGATION OF THE BURNING MECHANISM OF SOLID ROCKET PROPELLANTS T. Torda and W. J. Christian (Armour Research Found.) p 72–81 (See N63-15591 12-26)
16. COMBUSTION INSTABILITY IN SOLID PROPELLANT ROCKET MOTORS V. D. Agosta (Polytechnic Inst. of Brooklyn) p 82–85 (See N63-15592 12-26)
17. OSCILLATORY BURNING STUDIES Norman W. Ryan (Utah U.) p 86–87 (See N63-15593 12-26)
18. PROPELLANT MECHANICAL PROPERTIES Thor L. Smith (Stanford Research Inst.) p 88–92 3 refs (See N63-15594 12-26)
19. PRELIMINARY MEASUREMENTS OF THE DYNAMIC SHEAR COMPLIANCE OF A SOLID PROPELLANT R. C. Bryant (Atlantic Research Corp.) p 93–98 2 refs (See N63-15595 12-26)

20. NOTS RESEARCH ON COLLATERAL FACTORS IN COMBUSTION INSTABILITY E. W. Price (Naval Ord. Test Station) p 99–102 (See N63-15596 12-26)
21. STATUS OF EXPERIMENTAL STUDIES OF THE SUPPRESSION OF UNSTABLE BURNING H. Cheung (Aerojet-General Corp.) p 103 (See N63-15597 12-26)
22. COMPARATIVE ANALYSIS AND INTERPRETATION OF HIGH SPEED EXPERIMENTAL DATA ON INSTABILITY AND DETONATION PHENOMENA IN SOLID ROCKET COMBUSTION CHAMBER F. F. Liu (Quantum Dynamics) p 104 (See N63-15598 12-26)
23. THE OBSERVATION AND INTERPRETATION OF THE MODULATIONS OF INFRARED RADIATION AS A POSSIBLE MEANS OF INVESTIGATING ROCKET ENGINE INSTABILITY Donald J. Schmidt and H. G. Wolfhard (Reaction Motors Div., Thiokol Chemical Corp.) p 105–109 1 ref (See N63-15599 12-26)

N63-15577 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.

COMBUSTION INSTABILITY IN SOLID FUEL ROCKETS—ANATOMY 1962

F. T. Mc Clure *In its* Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 1–10 (See N63-15576 12-26)

A general outline of the areas of research on combustion instability in solid fuel rockets is presented. Primary emphasis is placed on acoustic resonance occurrence and effects. M.P.G.

N63-15578 Naval Ordnance Test Station, China Lake, Calif.

MEASUREMENTS OF OSCILLATORY BURNING

M. D. Horton *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 11–12 (See N63-15576 12-26)

The growth and decay rates of oscillations in a self-excited, one-dimensional burner are used to quantitatively characterize the response of a solid-propellant combustion zone to normally incident pressure waves. Test records show that both the growth and the decay of oscillations are exponential. Therefore, one-dimensional acoustics along with parallel treatment of growth and decay has been used to derive an equation for the acoustic admittance of the burning propellant surface. The constants involved in the solution are determined experimentally, and plots of the acoustic admittance as a function of frequency are presented. The data are also presented in a form representing the energy flux into the oscillation divided by the oscillatory energy level of the chamber. In general, the combustion driving of the oscillations was found to be inversely proportional to pressure. M.P.G.

N63-15579 Aberdeen Proving Ground. Ballistic Research Labs., Md.

SPECIFIC ACOUSTIC ADMITTANCE MEASUREMENTS OF BURNING SOLID PROPELLANT SURFACES BY A RESONANT TUBE TECHNIQUE

Richard Strittmater, Leland Watermeier, and Samual Pfaff *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 13–20 2 refs (See N63-15576 12-26) (Supported by BuWeps)

A resonant tube technique is used to measure the acoustic admittance of burning solid-propellant surfaces. The end plates of the tubular combustion chamber are designed so that the internal geometry of the chamber at ignition is the same for all thicknesses of propellant sample. The product gases are ejected through an orifice into a surge tank, and simultaneous pressure measurements are made at several locations along the length of the chamber. Test results indicate: (1) A minimum propellant sample thickness limit exists for obtaining comparable results: (2) The optimum sample thickness is about 0.350 in. (3) Near-equilibrium conditions must be obtained before measurements are made on the burning propellant: (4) The initial propellant thickness (web) and the web when the admittance measurement is made must be specified if results from different investigators are to be intelligently compared. M.P.G.

N63-15580 Aerochem Research Labs., Inc., Princeton, N.J.

ACOUSTIC ADMITTANCE MEASUREMENTS ON BURNING PROPELLANTS

D. W. Blair *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 21–23 (See N63-15576 12-26)

The ability of the propellant flame zone to add acoustic energy to an incident sound wave is investigated using an anechoic chamber. The sound wave from the face of the propellant is emitted into the chamber, passes through the chamber over a microphone, and is then absorbed by the chamber walls. A sample of acoustically driven propellant, surrounded by a guard ring of propellant which is not acoustically driven, is inserted into the chamber. First the guard ring is ignited and the microphone signal recorded; then the sample is ignited and the second signal recorded. The first signal is an indication of the pressure fluctuation at the surface of the propellant, and the second signal is an indication of equivalent injection and extraction of mass at the propellant surface. The ratio gives the response function of the burning surface. Preliminary results indicate that flame zone amplification is greatest at low frequencies (1.5 db at 1000 cps) and decreases at higher frequencies (0.3 db at 10,000 cps). Additional studies of the power vs. frequency spectrum of the sound generated by burning strands of solid propellant indicate that the sound power increases to a maximum at approximately 13,000 cps, and that variation of oxidizer particle size distribution affects the absolute value of the sound power but not the form of the spectral distribution curve. M.P.G.

N63-15581 Thiokol Chemical Corp., Elkton, Md.

MEASUREMENT OF THE SURFACE IMPEDANCE OF BURNING SOLID PROPELLANTS

A. O. Converse (Carnegie Inst. of Tech.) and E. S. Stern *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 24–26 (See N63-15576 12-26)

Mawardi's apparatus was modified to permit measurements of the acoustic impedance of burning solid propellants. The feasibility of using the modified apparatus was successfully tested with a burning propellant at 1000 psi. With increased chamber damping (by making more exhaust ports), the system can be considered linear so that surface acoustic impedance concepts can be applied. M.P.G.

N63-15582 Allegany Ballistics Lab., Hercules Powder Co., Cumberland, Md.

EXPERIMENTAL STUDIES OF SOLID PROPELLANT COMBUSTION INSTABILITY

T. A. Angelus *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 26a (See N63-15576 12-26)

Results of experimental studies of (1) the effects of long-term propellant storage on acoustic instability, (2) low frequency (nonacoustic) instability, and (3) acoustic properties of propellants are reported. The effect of long-term storage on the effectiveness

of metal additive suppression was found to be insignificant. A basic relationship was found between low frequency instability and chuffing, and both phenomena were related to combustion inefficiencies at very low operating pressure. Improvements in combustion efficiency were found to eliminate this nonsteady behavior. Sound absorption measurements made on double-base propellants indicate that variations of propellant temperature have a significant effect on sound absorption. M.P.G.

N63-15583 Stanford Research Inst., Menlo Park, Calif.
ACOUSTIC ADMITTANCE OF BURNING SOLID PROPELLANT SURFACE
G. M. Muller and G. A. Agoston *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., May. 8–9, 1962 May 1962 p 27–31 (See N63-15576 12-26)

A reflected pulse method for measuring the normal acoustic admittance of a burning propellant surface has been investigated. This method involves sending a plane acoustic pulse down a long tube that is terminated by the surface to be investigated, and observing the pressure-time profile of the pulse before and after reflection. The harmonic components of the incident and reflected pulses are obtained by taking Fourier transforms; from these, the reflection coefficient and hence the apparent admittance of the termination can be calculated. The true admittance is obtained by subtracting this apparent admittance from the apparent admittance obtained when the tube is terminated by a thick metal cap whose reflection coefficient is effectively unity. Therefore the effects of the unknown dissipative and nonlinear processes in the tube are cancelled out. A summary of experimental results obtained with a high-impedance sample (sandpaper cemented to an aluminum block) is presented which supports the validity of this method in the case of cold measurements. M.P.G.

N63-15584 Rocketdyne, Canoga Park, Calif.
EVALUATION OF A TRANSIENT METHOD FOR MEASURING ACOUSTIC IMPEDANCE
R. B. Lawhead *In* Applied Physics Lab., Johns Hopkins U. Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 32–34 (See N63-15576 12-26)

The use of a shock-tube transient technique to measure the acoustic impedance of a burning solid-propellant surface is investigated. This method consists of measuring the pressure-time histories of weak (pressure ratio less than 0.02) shock waves incident on and reflected from a material. A transient reflection coefficient is obtained from the pressure trace data by determining the ratio of the Fourier transform of the reflected pressure-time function to the transform of the incident pressure-time function. Experimental results for the acoustic impedance of an absorbing material (cellulose sponge) obtained by this transient method were in poor agreement with steady-state results. The transient technique was also applied to burning solid propellant samples in the shock tube at elevated pressures. Although problems were posed by a hot gas interface which reflected the shock, large differences in the response of stable and unstable propellants to the shock excitation were clearly evident from the raw data. M.P.G.

N63-15585 Aeronutronic Research Labs. Applied Physics Dept, Newport Beach, Calif.
PROGRAM FOR MEASURING THE SCATTERING OF SOUND BY GASEOUS FLAMES
H. M. Wight *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 35–39 (See N63-15576 12-26)
(Contract AF 49(638)-1106)

The various parameters influencing the reflection and scattering of low-intensity traveling acoustic waves by premixed gaseous flames are being experimentally investigated in order to determine the conditions under which a sound wave incident upon a combusting propellant can be reflected with enhanced energy. The electronic equipment for simultaneously displaying the incident sonic pulse energy and the scattered sonic energy is described. M.P.G.

N63-15586 Rocket Propulsion Establishment, Westcott (Gt. Brit.)
STABILITY GRADING OF SOLID PROPELLANTS BY THE OSCILLATORY STRAND BURNER TEST
J. Diederichsen *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 40–42 (See N63-15576 12-26)

The feasibility of establishing a stability rating for new solid-propellant formulations without the necessity of motor firings is being investigated. Theoretically, the stability can be determined by burning the sample under conditions of oscillating pressure and recording the instantaneous rate of energy release through the cycle of pressure oscillation. Experimentally, the variation of the light output from the reaction zone was chosen as a measure of the rate of energy release. A propellant known to be unstable and an untested propellant were burned in an oscillatory strand burner, and the difference between the oscillatory components of the light output from the two propellants was found to be significant. Further tests will be required to verify the initial assumptions and to determine whether a sufficient correlation exists between the oscillatory strand-burner test and full-scale motor firings. M.P.G.

N63-15587 Naval Ordnance Test Station, China Lake, Calif.
ABSTRACT OF REPORT TO SECOND SPIC TECHNICAL PANEL MEETING; NOTS RESEARCH ON LOW FREQUENCY COMBUSTION INSTABILITY
E. W. Price *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 43–50 (See N63-15576 12-26)

Low-frequency combustion-instability research is reported in the following areas: (1) screening commercial propellants for susceptibility to axial mode instability at 250 cps using a motor configuration which is particularly susceptible to instability; (2) exploring scaling laws for unstable combustion by testing scale versions of a center-vented burner in lengths from 6 to 60 inches; (3) exploring pressure-coupled acoustic instability in the frequency range from 10 to 120 cps; and (4) correlating and explaining existing observations of subacoustic instability. A quasi-steady-state explanation is advanced for subacoustic instability of the rocket motor system (as opposed to pure propellant instability) during the quenching part of the oscillation cycle. This explanation is based on the pressure dependence of combustion efficiency and burning rate in low pressure, short stay time situations. M.P.G.

N63-15588 Aberdeen Proving Ground. Ballistic Research Labs., Md.
SOME EXPERIMENTAL OBSERVATIONS OF ALUMINUM BURNING IN SOLID ROCKET PROPELLANTS
Leland Watermeier, William Aungst, and Samuel Pfaff *In* Applied Physics Lab., Johns Hopkins U. Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 51–58 5 refs (See N63-15576 12-26)

The role of aluminum in solid propellant combustion was investigated in order to determine (1) the possible role of aluminum in

low-frequency instabilities encountered in firings of highly aluminized propellants, (2) droplet burning rates and concentration gradients above the burning surface, and (3) the frequency range of amplification as related to initial aluminum particle size. The reported results indicate that the vibrations of liquid aluminum or aluminum-oxide-coated droplets are often in the low frequency (100 cps to 1000 cps) range; and the concentration profiles obtained for these droplets show that their vibrations can contribute to low-frequency instability phenomena. An appreciable agglomeration of aluminum occurs on the burning surface, and this agglomeration appears to be a function of pressure and concentration. Preliminary mass flux data indicate a considerable variation in the thin zones next to the surface; this variation may affect the acoustic admittance of the surface. Droplet evaporation or burning was found to occur at a large distance from the surface, indicating that there is a time lag in raising the droplet temperature. This lag may lead to greater participation of the aluminum droplets in gas phase damping of higher frequencies, especially at low pressures. M.P.G.

N63-15589 Canadian Armament Research and Development Establishment, Valcartier

CARDE INVESTIGATIONS OF FINITE WAVE AXIAL COMBUSTION INSTABILITY

L. A. Dickinson *In* Applied Physics Lab., Johns Hopkins U. Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1963 May 1962 p 59–66 3 refs (See N63-15576 12-26)

A pulse technique has been used to assess the finite-wave axial-combustion instability of aluminized, ammonium perchlorate/polyurethane propellant formulations. This technique is based on the assumption that if a pressure disturbance is introduced during burning at a time when the engine is in an incipiently unstable condition, amplification of the disturbing pulse will occur; conversely, if the engine is operating in the stable regime, pulsing should have no effect. Experimental data obtained using three propellant formulations and engines of two diameters are being used to delineate the effects of engine operating parameters, engine size, and diverse propellant factors. Concurrent studies of erosive burning indicate that propellants with high erosion factors may be more prone to finite-wave axial-combustion instability. M.P.G.

N63-15590 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.

ON ACOUSTIC AMPLIFICATION AND ATTENUATION BY BURNING SOLID PROPELLANTS

R. W. Hart *In its*Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 67–71 (See N63-15576 12-26)

The present state of the theory of acoustic amplification and attenuation by burning solid propellants is reviewed. Also a theory is proposed that includes the effect of the acoustic boundary layer on the acoustic response of burning propellants. Although this transition region has been neglected in previous calculations, the transition effects observed between the isentropic acoustic field and the combustion zone are found to be significant. The corrected acoustic-response theory permits the calculation of the equivalent reduced admittance from experimentally derived measurements of the equivalent reduced admittance from experimentally derived measurements of the rate of growth and decay of the acoustic field. M.P.G.

N63-15591 Armour Research Foundation, Chicago, Ill.

ANALYTICAL INVESTIGATION OF THE BURNING MECHANISM OF SOLID ROCKET PROPELLANTS

T. P. Torda and W. J. Christian *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 72–81 (See N63-15576 12-26)

In order to ultimately obtain a time-dependent theory for the erosive burning of solid propellants, a simplified fluid dynamic model is being analyzed. This laminar flow, steady-state model with simplified reaction kinetics is being formulated so that subsequent inclusion of time variable phenomena and more sophisticated chemistry will present no essential difficulty. M.P.G.

N63-15592 Polytechnic Inst. of Brooklyn, N.Y.

COMBUSTION INSTABILITY IN SOLID PROPELLANT ROCKET MOTORS

V. D. Agosta *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 82–85 (See N63-15576 12-26)

Nonlinear aspects of gas- and wave-dynamics occurring in solid propellant rocket motors are studied to determine the criteria for predicting stable motor operation. Programs are generated which describe wave behavior from a mechanistic point of view and which allow the maximum freedom for coupling such phenomena as chemical kinetics, evaporation, sublimation and condensation kinetics, equilibrium thermochemical processes, heat and mass transfer, and other transport processes. Analyses are presented for (1) continuous wave dynamics, (2) shock wave dynamics, (3) normal shock reflection in an end-burning rocket motor, and (4) chemical kinetic-wave dynamic coupling by means of flash pyrolysis. M.P.G.

N63-15593 Utah U., Salt Lake City

OSCILLATORY BURNING STUDIES

Norman W. Ryan *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 86–87 (See N63-15576 12-26)

Oscillatory burning is being studied using a side-rented cylindrical chamber for burning end-burning propellant grains. This burner is acoustically one-dimensional, but permits only axial modes of oscillation. The propellant tested is a laboratory-manufactured polybutadiene acrylic acid copolymer (epoxy cure), ammonium perchlorate–copper chromite formulation. A series of tests run at fixed-gas column length show that, although the ratio of pressure amplitudes is near unity over most of the range of solid-propellant lengths studies, a sharp peak occurs at the propellant length (resonant length) matching the gas column length. When longer grains, exhibiting strong oscillations, are burned through the resonant length, the amplitudes of the oscillations diminish sharply and sometimes vanish. Oscillations frequently reappear, however, as the grain burns to shorter-than-resonant length. The study also demonstrates that the acoustics of one-dimensional, two-phase systems can be produced and quantitatively described. M.P.G.

N63-15594 Stanford Research Inst., Menlo Park, Calif.

PROPELLANT MECHANICAL PROPERTIES

Thor L. Smith *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 88–98 3 refs (See N63-15576 12-26)

The mechanical behavior of solid propellants that are subjected to small oscillating deformations is studied in order to (1) understand the influence of mechanical properties on unstable combustion and (2) analyze grain dynamics during missile transport and flight. The acoustic energy, which influences combustion instability, may dissipate in the solid as both shear and dilatational waves. The characteristics of such waves are specified in terms of a complex bulk modulus; both moduli are functions of frequency and temperature. Apparatus are described for measuring both moduli in solid propellants under small deformations. In addition, the possibility of

determining the large deformation time-dependent tensile properties from data obtained by relatively standard methods using an Instron tester is being investigated. M.P.G.

N63-15595 Atlantic Research Corp., Alexandria, Va.
PRELIMINARY MEASUREMENTS OF THE DYNAMIC SHEAR COMPLIANCE OF A SOLID PROPELLANT
R. C. Bryant *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 93–98 2 refs (See N63-15576 12-26)

Measurements of the dynamic shear compliance of an aluminized polybutadiene–acrylic acid–acrylonitrile copolymer solid propellant are being made because such measurements are a direct indication of the dissipation of energy in burning propellant systems. A Fitzgerald apparatus is used to determine the effects of temperature and frequency, aging, handling, and moisture on the loss compliance of propellant samples. Although the reported data are preliminary, they are useful in determining representative sample parameters which will permit reproducible measurements. M.P.G.

N63-15596 Naval Ordnance Test Station, China Lake, Calif.
NOTS RESEARCH ON COLLATERAL FACTORS IN COMBUSTION INSTABILITY
E. W. Price *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 99–102 (See N63-15576 12-26)

Results of the following investigations are presented: (1) the effect of aluminum particle size and concentration on combustion instability; (2) the stability and combustion of pure ammonium perchlorate charges; and (3) the effect of acoustic environment on propellant burning rate. Results showed that: (1) The suppression of high-frequency instability (18,000 cps to 5,000 cps) of nitrasol and polyurethane-ammonium perchlorate propellants is very sensitive to particle size and to aluminum concentration. Particle damping of the acoustic waves in the gas is a major factor and possibly a dominant factor in the stabilizing effect of aluminum at high frequency. (2) The contribution of the ammonium perchlorate decomposition process to oscillatory combustion is low (at 3,600 cps), or at least it is not a dominant factor in the behavior of ammonium perchlorate propellants. (3) Propellant burning rates are reduced in environments of acoustic pressure (3,000 cps to 4,000 cps). The reduction is several times that predicted by steady-state burning behavior. It is more severe for double-base than for composite propellants. The burning rates are increased by environments of tangential velocity oscillations; the response is roughly the same for double-base and composite propellants. I.v.L.

N63-15597 Aerojet-General Corp., Azusa, Calif.
STATUS OF EXPERIMENTAL STUDIES OF THE SUPPRESSION OF UNSTABLE BURNING
H. Cheung *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 103 (See N63-15576 12-26)

The combustion instability program includes the following studies: (1) the effects of unstable combustion on the kinetics of chemical reactions in the vicinity of the burning surface, (2) occurrence and suppression of low-frequency instability, (3) deflagration stability of ammonium perchlorate grains, and (4) effect of particle size on combustion stability. Results are given for the first two areas, (1) and (2): aluminum oxide produces an accelerating effect on the decomposition of perchlorate acid; a propellant containing coarse oxidizer and 8% aluminum has been observed to have a high incidence of low frequency (< 1000 cps) instability. D.E.R.

N63-15598 Quantum Dynamics, Tarzana, Calif.
COMPARATIVE ANALYSIS AND INTERPRETATION OF HIGH SPEED EXPERIMENTAL DATA ON INSTABILITY AND DETONATION PHENOMENA IN SOLID ROCKET COMBUSTION CHAMBER
F. F. Liu *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 104 (See N63-15576 12-26)

Some interpretation of the experimentally obtained very-high-speed data on dynamic combustion phenomena are presented and the results are analyzed. To obtain an overall appreciation of the significant regimes to which dynamic combustion phenomena may be divided, comparative analyses are made on both the instability and detonation phenomena, dealing with the phenomenological patterns related to the initiation of instability by perturbations in the chamber, the development and generation of the harmonics, and the generation of multimode shock waves. Detail experimental data on the deflagration-to-detonation transitional phenomena are presented for the first time in order to illustrate an extreme case of solid-propellant-combustion disturbances. These works bring forth the significant revelation of time lag and relaxational phenomena which have long been suspected in theories. The existence of negative erosive coefficient and the plausible pattern of flame-gas movement in the chamber are also discussed on the context of experimental data. Efforts are also made to evaluate the degree of agreement and disagreement between existing theories and recent experimental findings. Author

N63-15599 Reaction Motors Div., Thiokol Chemical Corp., Denville, N. J.
THE OBSERVAION AND INTERPRETATION OF THE MODULATIONS OF INFRARED RADIATION AS A POSSIBLE MEANS OF INVESTIGATING ROCKET ENGINE INSTABILITY
Donald J. Schmidt and H. G. Wolfhard *In* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Technical Panel on Solid Propellant Combustion Instability Proc. of Second Meeting, Stanford Res. Inst., Menlo Park, Calif., Mar. 8–9, 1962 May 1962 p 105–109 1 ref (See N63-15576 12-26)

The modulations of infrared radiation caused by fluctuations of thermodynamic factors, such as pressure and temperature, have been observed and interpreted as a possible means of studying rocket engine instability. A mathematical method of determining the degree of correlation of the fluctuations was derived and the formula defined. Experimental work, using a tunnel burner and vented combustion vessel with an experimental rocket engine that burned gaseous propellants, was conducted to detect the onset of engine stability, and observe it as it develops. Experiments with this apparatus to date indicate that it is a feasible technique for observing instability. D.E.R.

N63-15604 Douglas Aircraft Co., Inc. Missile and Space System Div., Santa Monica, Calif.
HYPERVELOCITY STUDIES USING HYPERVELOCITY IMPULSE TUNNEL
J. A. Copper *In its* Results of Independent Research and Development Studies by the Douglas Aerophysics Laboratory Staff in Fluid Mechanics and Simulation Techniques, Fiscal Year 1962 Jan. 1, 1963 26 p 18 refs (See N63-15601 12-10)
(SM-41379-3)

Gasdynamic techniques required to enable the hypervelocity impulse tunnel (HIT) to reach its designed limits of performance, including velocities up to 20,000 ft/sec and run times of at least 10 milliseconds, have been tentatively verified in auxiliary experiments. Operation and control of a combustible mixture of hydrogen and oxygen, diluted by helium or nitrogen, have been demonstrated in the drive section of a three-inch shock tube, and have subsequently been applied with good results in the six-inch drive section of the HIT. The tailored-interface and equilibrium-interface techniques and the steady driver-expansion technique at the principal

diaphragm have been practiced successfully in the three-inch shock tube, all with a combustion drive. However, the use of an orifice at the principal diaphragm to prolong the steady test duration appears to be of marginal value in the range of conditions studied. Analytical methods for determining airflow test conditions have been investigated. Instrumentation suitable for the shock tunnel environment is being developed. Progress therein, as well as preliminary tunnel calibration, is reported. Author

N63-15686 Polytechnic Inst. of Brooklyn, N.Y.
TRANSPIRATION COOLING OF A TURBULENT BOUNDARY LAYER IN AN AXISYMMETRIC NOZZLE [Interim Report]
Joseph Librizzi and Robert J. Cresci Wright-Patterson AFB, Ohio, Aeronautical Res. Labs., Feb. 1963 58 p 28 refs
(Contract AF 33(616)-7661)
(PIBAL-772)

This report presents the results of an experimental investigation of the downstream influence of mass injection on the heat transfer to the surface of an axisymmetric nozzle in turbulent flow. Helium and nitrogen are used as coolants and are injected through a porous region upstream of the nozzle throat at various rates. The high-temperature, high-pressure environment is obtained by burning methane and oxygen in a chamber well upstream of the model. Stagnation temperatures of between 1600° R and 2600° R were achieved. The average specific heat ratio (γ) of the gas products is 1.29. The results of the experiments show a decrease in heat transfer with increasing mass injection, helium being more effective for the same mass flow rate than nitrogen. This decrease in heat transfer becomes less prominent as the distance downstream of the porous region increases. Author

N63-15735 Army Chemical Center, Edgewood, Md.
HANDLING AND STORAGE OF NITROGEN TETROXIDE [Final Report]
Edwards, Calif., Air Force Systems Command, Rocket Propulsion Lab., May 1963 106 p
(Contract AF 33(616)60-20)
(RTD-TDR-63-1033)

A comprehensive source of basic information for use in the design, fabrication, and operation of nitrogen tetroxide handling equipment is presented. The chemical and physical properties of this propellant are included so that the hazards will be recognized and understood. Principles underlying the prevention of fire, explosion, and toxic effects are presented, along with the information on the disposal and neutralization of vapors and liquids. Author

27 PROPULSION

Includes: airbreathing, electric, liquid, nuclear, and solid propulsion.

For related information see: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N63-15259 Liquid Metals, Inc., Westford, Mass.
RESEARCH ON FUNDAMENTAL ELECTRODYNAMIC AND HYDRODYNAMIC PHENOMENA INVOLVED IN ELECTROMAGNETIC PUMPING OF LIQUID METALS Final Report [Mar. 15, 1961]-Mar. 31, 1962
G. R. Findlay [1962] 123 p
(NASA Contract NASr-33)
OTS: $10.10 ph, $3.89 mf

A theoretical analysis of the fundamental principles of magnetohydrodynamic flow of liquid metals in any type electromagnetic pump is presented. The inherent advantages and potential limitations of each of four types of electromagnetic pump are discussed along with the major problems that affect design of a lightweight, efficient, and reliable pump. A study made of the various pumping requirements is reported. The potential areas of application for different type EM pumps in these space powerplant systems is indicated. A detailed circuit analysis is made for the electrodynamic-type pump. In addition, an example is presented of the weight and weight penalty possible for the electrodynamic pumps which might be used in a potentially typical 2,000 Kle) nuclear, turbodynamic, space powerplant system. To supplement theoretically calculated performances of a number of electrodynamic pumps, an exploratory experimental program is presented and discussed. This program includes performance measurements on six different types of electrodynamic pumps covering flow ranges to 65 gallons/minute with developed pressure to 250 psi and operating temperatures to 1400° F, and with sodium, NaK, and potassium as the working fluid. Author

N63-15299 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
APPLICATION OF CRYOGENIC PROPULSION TO SPACE MISSIONS
Bruce T. Lundin [1963] 20 p Presented at the 31st Annual IAS Meeting, N.Y., Jan. 22, 1963

This review includes: (1) energy requirements for scientific missions wherein the total mission velocity increment is plotted against the perihelion distance of a solar probe with two horizontal dashed lines indicating the requirements of a planetary probe and a planetary orbiter; (2) a kick stage atop an Atlas Centaur; (3) solar probe payloads which may be placed at various perihelion distances for the following four different stages: pressurized hydrogen-fluoride, pumped hydrogen-fluoride, pumped hydrogen-oxygen, and a pressurized earth storable stage; (4) Mars orbit payloads for various insertion stages; (5) a cryogenic service module; (6) the theoretical duration capability of ablation chambers; (7) ablative nozzle weight losses; and (8) a comparison of launch vehicles and payload reliability trends. I.v.L.

N63-15352 Little (Arthur D.) Inc., Cambridge, Mass.
DEVELOPMENT OF PYROLYTIC REFRACTORY MATERIALS FOR SOLID-FUEL ROCKET MOTOR APPLICATIONS Quarterly Status Report No. 2 [Oct. 10, 1961-Jan. 10, 1962]
Ronald Francis Jan. 10, 1962 34 p 6 refs
(Contract DA-19-020-ORD-5490)
(WAL-TR-766.41/3)

Continued investigations of the preparation and evaluation of refractory metal alloys of pyrolytic graphite as a function of synthetic parameters are presented. Induction-furnace modifications for vapor plating to temperatures in excess of 2500° C, development of analytical techniques, development of coating procedures on complex shapes, and additional oxidation data of the materials are reported. Methods of producing satisfactory coatings of various pyrolytic graphites and alloys on graphite nozzles for test firings with Arcocel 163 (6500° F, aluminized) propellant are also described. Author

N63-15377 Atlantic Research Corp., Alexandria, Va.
DEVELOPMENT OF FLEXIBLE POLYMERS AS THERMAL INSULATION IN SOLID-PROPELLANT ROCKET MOTORS Quarterly Progress Report, Oct. 1 to Dec. 31, 1962
T. R. Walton, E. B. Simmons, and R. O. Thomas Jan. 1963 39 p 1 ref
(Contract DA-36-034-ORD-33325 RD)

Twelve epoxy resins were tested in the oxyacetylene-torch test and compared with U.S. Rubber Company's 3016 and General Tire and Rubber Company's V-44. The insulation performance rating of these materials in the torch gave poor agreement with what has been observed in static-motor firings. The Guardians modified with

40 percent of castor oil and filled with 13 or 20 percent of asbestos showed best insulation performance, and that loaded with 40 percent of asbestos the worst; this is the reverse of what has been observed in static-motor firings. Ten epoxy resins were tested in static-motor firings this report period. The best material, a formulation of an Epon 828, tetrahydrophthalic anhydride, and castor oil filled with 40 percent of asbestos fibers, had a char rate of 0.8 mil/sec. Two flexible furan resins were prepared from liquid furan polymers. In one case the resin was cured at low temperatures with 5 percent of a long-chain diacid and in the other the resin was cured with a long-chain diepoxide. Several flexible polyester resins were prepared from saturated aliphatic glycols and saturated and unsaturated aliphatic acids or anhydrides. Crosslinking was accomplished by dicumyl peroxide. The ester with the best mechanical properties was prepared from propylene glycol, succinic anhydride, and maleic anhydride. Flexible polyurethane resins were prepared from a liquid urethane polymer (Adiprene L 100) and several epoxy resins (using 4,4'-methylene-bis-2-chloroaniline as the curing agent) and N,N,N',N'-tetrakis(2-hydroxypropyl)ethylene diamine. Author

N63-15400 Army Missile Command, Redstone Arsenal, Ala.
MATERIAL OPTIMIZATION FOR LIQUID PROPULSION SYSTEMS
B. Steverding Nov. 8, 1962 18 p 3 refs
(RR-TR-62-7)

A mathematical method is developed by means of which the suitability of materials for the construction of liquid-propellant thrust chambers is determined. Among the various candidate materials, alloys with specific property spectra are evaluated so that the basic function of a heat-exchanger material is satisfied under conditions of high strength, minimum weight, reliability, and short-time application. A dimensionless factor is calculated, for a number of candidate alloys, which determines the feasibility of the specific metal for thrust-chamber construction. Author

N63-15546 Arde-Portland, Inc., Paramus, N.J.
COOLED SOLID PROPELLANT ROCKET NOZZLES Summary Report No. 3, Jan. 1-Mar. 31, 1962
Philip Wachs [1962] 19 p
(Contract DA-30-069-ORD-3099)

Progress in the development of new techniques for maintaining the structural integrity of rocket exhaust nozzles to operate for long durations in high-temperature core gas environments is outlined here. The principal work concerns evaluating the feasibility of applying liquid rocket-engine cooling techniques to solid rocket nozzles; the more promising techniques use liquid lithium as the coolant. D.E.R.

N63-15667 Little (Arthur D.), Inc., Cambridge, Mass.
DEVELOPMENT OF PYROLYTIC REFRACTORY MATERIALS FOR SOLID-FUEL ROCKET MOTOR APPLICATIONS Quarterly Report No. 3
Ronald Francis Apr. 10, 1962 33 p 4 refs
(Contract DA-19-020-ORD-5490)
(WAL-TR-766.41/2-2)

The basis for material selection, principles of alloy preparation, analytical evaluation, and test-nozzle preparation are the principal topics. The effect of synthetic variables, particularly choice of source, deposition rate, deposition temperature, and heat treatment on pyrolytic graphite density, microstructure, lattice parameters and preferred orientation, and on the stoichiometry of pyrolytic graphite alloys, is described. Many of the considerations significant to the development of test rocket-nozzle inserts of pyrolytic boron nitride, pyrolytic graphite, and graphite alloys of boron, silicon, and zirconium are given in detail. Author

N63-15681 General Electric Co. Space Power and Propulsion Section, Cincinnati, Ohio
SPACECRAFT ELECTRIC GENERATING AND PROPULSION SYSTEM INTEGRATION First Quarterly Status Report for Month Ending June 30, 1962
[1962] 56 p 2 refs
(Contract AF 33(657)-8488)

CONTENTS:
1. APPLICATION OF A 300 KW ARC JET PROPULSION SYSTEM H. E. Nicoll, Jr. p 1–19 (See N63-15683 12-27)

N63-15682 General Electric Co. Space Power and Propulsion Section, Cincinnati, Ohio
APPLICATION OF A 300 KW ARC JET PROPULSION SYSTEM
H. E. Nicoll, Jr. *In its* Spacecraft Electric Generating and Propulsion System Integration First Quarterly Status Report Apr. 26, 1962 p 1–19 1 ref (See N63-15681 12-27)
(DM 62-126)

Preliminary mission analyses have been initiated to determine the applicability of a 300-kw arc jet-propulsion system in the performance of satellite distribution, maintenance, and repair functions. Three basic vehicle configurations have been assumed; the associated low earth-orbital weights are 25000, 19000, and 8500 lbs. Theoretical engine performance characteristics are based on the use of hydrogen propellant at specific impulse levels of 1000, 1250, and 1500 seconds. Orbital altitudes of 300 n. miles and 22200 miles (the 24-hour orbit) have been assumed. Author

N63-15695 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
DESIGN AND OPERATIONAL PERFORMANCE OF A 150-KILOWATT SODIUM FLASH-VAPORIZATION FACILITY
Landon R. Nichols, Charles H. Winzig, Stanley M. Nosek, and Louis J. Goldman Washington, NASA, May 1963 52 p 5 refs
(NASA TN D-1661) OTS: $1.50

The mechanical, electrical, and process design, and the operational performance of a 150-kilowatt sodium flash-vaporization facility are presented. Saturated liquid sodium at temperatures to 1600° F was circulated at flow rates to 19,000 pounds per hour through an electric-resistance heater. A maximum heater-outlet temperature of 1700° F is attained prior to decompression of the liquid to allow fractional flash vaporization. The liquid-vapor mixture is separated centrifugally, the saturated liquid is recirculated, and the saturated vapor is passed through a convergent nozzle, which simulates a turbine. Stable system operation is realized throughout the range of design parameters. No process instabilities occurred in the flashing process during either transient or steady-state operation. Tentative restricted and critical-flow data of sodium vapors through a convergent nozzle are presented and are compared with theoretically predicted flow for supersaturated and equilibrium expansions. An account of the operational problems, process characteristics, and process interruptions encountered during the 800-hour performance run are presented. Author

28 SPACE RADIATION

Includes: cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts.

For related information see: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N63-15286 Minnesota U., Minneapolis

SYMPOSIUM ON AEROSPACE RADIOBIOLOGY. I. SOLAR INFLUENCES ON THE RADIATION FIELD IN SPACE

J. R. Winckler Repr. from Aerospace Med., v. 32, Oct. 1961 p 893–900 13 refs Presented at the 32nd Annual AMA Meeting, Chicago, Apr. 25, 1961

(NASA Contract NASw-56)

A series of fourteen solar cosmic ray events were investigated in the light of: (1) the energy spectra and composition of the solar cosmic rays and (2) the time variations and the resulting implications about propagation from sun to earth. These events were selected because direct measurements have been made on the primary particles by means of balloons or rockets. Most of the major events for the period 1958 through 1960 are included. I.v.L.

N63-15290 Minnesota U. School of Physics, Minneapolis

THE 0.5-MEV GAMMA-RAY AND THE LOW ENERGY GAMMA-RAY SPECTRUM TO 6 GRAMS PER SQUARE CENTIMETER OVER MINNEAPOLIS

Laurence E. Peterson (California U.) Repr. from J. Geophys. Research, v. 68, no. 4, Feb. 15, 1963 p 979–987 15 refs Presented at the Meeting of the American Physical Soc., Los Angeles, Dec. 1961

(NASA Contract NASw-56)

(CR-62)

The positron annihilation line at 0.5 mev has been found to be a prominent feature of the low-energy γ-ray spectrum produced in the atmosphere by cosmic rays. The measurement, which covered the energy range between 37 kev and 3.5 mev, was made with a phoswich scintillation counter carried on a balloon to a depth of 6 g/cm^2 over Minneapolis. The flux at 0.5 mev was found to be 0.31 $\pm$0.03 photon/cm^2 sec at 6 g/cm^2, and when extrapolated to zero depth, gave a residual of 0.18 $\pm$0.03 photon/cm^2 sec. All components of the spectrum, including the line at 0.5 mev, were observed to have a transition maximum at 90 g/cm^2 and a length for absorption of 180 g/cm^2. These indicate the origin of the low-energy γ-rays to be associated with the electronic component of secondary cosmic rays. Evaluation of the source function at 0.5 mev over the entire atmospheric column gives 8.6 positrons per incident primary cosmic ray at $\lambda = 55°$ geomagnetic. Since no statistically significant time variations were observed during the seven hours of constant depth balloon flight, an upper limit on the flux of certain possible extraterrestrial point sources, which made high-elevation meridian transits, can be obtained. The flux at 0.5 mev from the quiet sun and from the Crab nebula must be less than about 0.1 photon/cm^2 sec at the earth. Author

N63-15314 Minnesota U., Minneapolis

SOLAR COSMIC RAY EVENT OF SEPTEMBER 3, 1960. II-38-20

P. D. Bhavsar Repr. from J. Phys. Soc. Japan, v. 17, Supp. A-II, 1962 p 329–334 5 refs Presented at the International Conf. on Cosmic Rays and the Earth Storm, Part II

(NASA Contract NASw-56)

Simultaneous balloon observations from two different latitudes were made during this solar cosmic-ray event. A very remarkable feature of delayed propagation of solar cosmic rays through interplanetary space was studied. This delay was caused by the passage of solar cosmic rays through magnetic plasma clouds from previous flares. The delay was energy-dependent and could be easily seen from the time variations of the solar proton-energy spectrum and intensity variations at two locations. The spectrum became steep, as the time passed, because of the late arrival of the low-energy particles. Most of the time during the event, the intensity of solar cosmic rays at Minneapolis was lower than that at Churchill because of the higher geomagnetic cutoff at Minneapolis. This intensity became comparable at both the stations during the main phase of the magnetic storms, indicating that the geomagnetic cutoff at Minneapolis is removed during the main phase. Author

N63-15316 Kodaikanal Observatory (India)

DISTRIBUTION OF SUNSPOTS IN LONGITUDE

A. S. Ramanathan and R. Jayanthan Nov. 1, 1962 5 p 1 ref (Bulletin No. CLX)

A study of the distribution of sunspot activity in longitude has been made for six solar cycles covering the period 1889 to 1954. Correction for differential rotation for individual groups has been made. The study has revealed that (a) spot activity integrated over a complete cycle shows meridional structure, (b) the centers of spot activity show occasional migration in longitude; but this migration is neither regular nor always in the same direction. Author

N63-15358 Smithsonian Astrophysical Observatory, Cambridge, Mass.

SOLAR RADIO BURSTS OF SPECTRAL TYPES II AND IV: THEIR RELATIONS TO OPTICAL PHENOMENA AND TO GEOMAGNETIC ACTIVITY

Barbara Bell (Harvard Coll. Obs.) Washington, Smithsonian Inst., 1963 22 p 7 refs

(*Its* Contrib. to Astrophys., v. 5, no. 15) GPO: $0.30

Solar radio bursts of spectral types II and IV, observed in the years 1957 to 1960, are discussed in relation to flares, the magnetic class of the associated sunspot, the north-south asymmetry, and to geomagnetic and solar proton (PCA) effects. A total of 96 type IV and 197 type II bursts were studied. About 50 percent of the type IV and 28 percent of the type II bursts were associated with a major ($\geq 2^+$) flare. Sunspot groups of complex ($\beta\gamma$ and γ) magnetic class produced 61 percent of the type IV but only 36 percent of the type II bursts. Comparative data are given for sunspots, flares, and geomagnetic storm and PCA sources. The north-south asymmetry appears to increase with increasing intensity in various types of solar activity. Long-lived bursts of each type are more concentrated to the north than are short-lived bursts. But there is no significant difference between type II and type IV bursts in north-south distribution. The data indicate a very strong association between type IV bursts and great geomagnetic storms. The increase in probability of a great storm within three days after a type II burst is also significant but less striking. However, those type II bursts that were not accompanied by type IV appear to be significantly associated only with small storms. Author

N63-15360 National Aeronautics and Space Administration, Washington, D.C.

ADDITIONAL STATUS REPORT ON TRAPPED ELECTRONS FROM THE STARFISH HIGH ALTITUDE NUCLEAR TEST News Release

Feb. 4, 1963 10 p A Joint Report Prepared by the AEC, Department of Defense, and NASA

A Starfish high-altitude nuclear explosion over Johnston Island in the South Pacific on July 9, 1962, created an artificial electron belt. The electron fluxes following the test were sufficiently high to accelerate the deterioration of exposed solar cells on three experimental satellites which were not designed for these increased radiation levels. Improved types of solar cells which are considerably more radiation resistant are available and have been employed by Telstar. The artificial belt is not regarded as placing a significant restriction on the conduct of current manned space flights as the capsule design effects a considerable reduction in radiation exposure. J.A.J.

N63-15445 Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

DYNAMICAL PROPERTIES OF STELLAR CORONAS AND STELLAR WINDS. I. INTEGRATION OF THE MOMENTUM EQUATION

E. N. Parker [1963] 56 p 22 refs Submitted for Publication

(NASA Grant NsG-96-60)

(EFINS-63-18) OTS: $5.60 ph, $1.88 mf

The hydrodynamic-momentum and mass-flow equations are integrated for a stellar corona with spherical symmetry about the center of the star. The coronal temperature is taken to be a known function T(r) of radial distance. The general properties of the equations are discussed, and it is shown that if the corona is tightly bound by the solar gravitational field, so that the thermal velocity is small compared to the gravitational escape velocity, and if the coronal temperature declines outward more slowly than $1/r$, then the corona is quasi-static at its base and expands to supersonic velocity in space. The stellar mass loss resulting from the expansion is determined entirely by the coronal temperature between the base of the corona and the point at which the flow becomes supersonic. The amount by which the velocity of the resulting stellar wind exceeds the thermal velocity in the corona depends principally upon the temperature beyond the point where the flow becomes supersonic. Author

N63-15553 International Geophysical Year World Data Center A: Solar Activity, High Altitude Observatory, Boulder, Colo.

INTERMEDIATE REPORT OF PROMINENCE (FILAMENT) ACTIVITY, JANUARY-DECEMBER 1962

Washington, Natl. Acad. of Sci., May 1, 1963 50 p
(IGY Solar Activity Rept. Series 22)

This compilation of prominence data from cooperating solar observatories is a continuation of reports which were formerly entitled "Intermediate Reports of Surges and Active Prominence Regions." Active filaments and prominences, bright and dark surges, and radiations are among the features cited. J.A.J.

N63-15616 Minnesota U., Minneapolis

SOLAR PROTONS AND α PARTICLES FROM THE SEPTEMBER 3, 1960, FLARES

S. Biswas (NASA, Goddard Space Flight Center), P. S. Freier, and W. Stein Repr. from J. of Geophys. Res., v. 67, no. 1, Jan. 1962 p 13–24 6 refs
(NASA Contract NASw-56)

The solar-proton differential-energy spectra have been measured in emulsions during four flights in the 48-hour interval following the class 3+ solar flare at 0110 UT on September 3, 1960. During these times the spectra can be expressed as $dN/dE = \text{const}\ E^{-8}$, where the constant is a decreasing function of time. The cutoff energy imposed by the earth's magnetic field at Minneapolis, Minnesota, is not sharp even before the sudden commencement of the magnetic storm. During the magnetic storm the cutoff energy is lowered. Solar α particles are observed with an abundance of 3 to 7 percent of the solar protons of the same rigidity. This abundance ratio is 3 percent before the magnetic storms and becomes higher during the times of the storms. Author

N63-15687 Eastman Kodak Co. Apparatus and Optical Div., Rochester, N.Y.

SPACE BACKGROUND STUDY Semi-Annual Report [Jan. 1-July 1, 1962]

Philip Barnhart (Ohio State U. Res. Foundation), W. Haynie, Joseph Schliff, and E. Paul Ertsgaard July 31, 1962 25 p
(Contract DA-30-069-ORD-3516; ARPA Order 39-60; Proj. Defender)
(EK/ARD ED-874)

This document describes the progress of the Space Background Study which is a continuation of the initial efforts expended to characterize the stellar background. A review of the progress made on eliminating variabilities introduced by atmospheric extinction and transparency, random wandering of the sharp star image across the nonuniform photoconductive surface, and detector sensitivity changes are presented. Refinements made to the instrument and improved observing techniques to eliminate other variabilities are also discussed. Measurements taken with the photometer on the 32-inch reflector at Perkins Observatory are presented, reduced to IR magnitude. Author

N63-15748 National Aeronautics and Space Administration, Washington, D.C.

"WEATHER" IN SPACE

J. S. Butz, Jr., ed. Repr. from Air Force/Space Dig. [1963] 11 p

Solar spots and flares are the visible signal for the release of energetic particles which upon arrival at the earth create auroras, communications, blackouts, compress the earth's magnetic field, alter the composition of the Van Allen Radiation Belt, and start many types of ionospheric disturbances. One of the major goals of solar research is to find a means of predicting precisely when a proton outburst will be directed at the earth and how intense that outburst will be. Shielding to protect man in space from these radiation hazards is being perfected. J.A.J.

29 SPACE SCIENCES

Includes: space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories.

For space biology see: 16 Life Sciences.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N63-15251 California U., Berkeley. Space Sciences Lab.

FAULT MECHANICS OF THE LUNAR STRAIGHT WALL AND THE NATURE OF MARE MATERIAL

Robert G. Strom Jan. 1963 21 p 15 refs
(NASA Grant NsG-145-61)
(*Its* Ser. 4, Issue 8) OTS: $2.60 ph, $0.83 mf

The principles of fault mechanics are applied to the Straight Wall in order to delimit the nature of the mare material in its vicinity. The magnitude of the components of displacement and the gross mechanical properties of the fractured material are derived. Movement along the Straight Wall fault resulted in a maximum crustal lengthening of about 345 meters. The hade (θ) of the Straight Wall is approximately 43°, hence the coefficient of internal friction (μ) and the ratio (n) of the compressive-to-tensile strength of the material is about 0.059 and 1.14, respectively. The large hade (θ) and small values of μ and n accord with the mechanical properties of a very weak material whose average compressive strength is probably less than 600 kg/cm^2. Further, this low mechanical strength must persist to a depth equivalent to the vertical displacement of the fault; that is, to a depth of at least 200-300 meters. This indicates that the mare material does not possess a strength comparable to terrestrial granites or dense basalts. The materials most likely to account for the gross mechanical properties are (1) extremely porous, low-density lava flows primarily consisting of rock froths (reticulite or scoria), (2) very porous tuffs or semi-welded ignimbrites, or (3) a combination of (1) and (2). Recent radiometric, photometric, and polarimetric investigations offer corroborative evidence supporting the results of the present study. Author

N63-15257 National Aeronautics and Space Administration, Washington, D.C.

THE U.S. SPACE PROGRAM

Hugh L. Dryden [1963] 9 p Presened at the Annual Dinner Meeting of the Pittsburgh Post, Soc. of American Military Engr., Apr. 2, 1963
OTS: $1.10 ph, $0.80 mf

The space program of the United States in the light of (1) the advancement of space science and technology, (2) the application of the resulting knowledge to the design of earth satellites for such purposes as weather and communications satellites, and (3) the exploration of space with manned vehicles is reported in this summary. The objectives, motivations, costs, and values of space development are also discussed. D.E.R.

N63-15274 Cincinnati U. Observatory, Ohio

PERIODIC LIBRATIONS ABOUT THE TRIANGULAR SOLUTIONS OF THE RESTRICTED EARTH-MOON PROBLEM AND THEIR ORBITAL STABILITIES

Eugene Rabe and Allan Schanzle Repr. from the Astron. J., v. 67, no. 10, Dec. 1962 p 732–739 3 refs
(NASA Grant NsG-43-60)

The methods previously used in the search for periodic Trojan orbits (Rabe 1961, 1962) are applied here to the determination of periodic orbits in the plane restricted earth-moon problem. Fourteen periodic orbits have been established, on the IBM-650 electronic computer, to the same degree of numerical accuracy. The orbits of larger amplitudes are of rather unexpected geometric shapes, which are related to the emergence of four points of minimum orbital velocity, instead of the familiar two, for all the long-period librations in the corresponding Trojan problem. Harmonic analysis is used to obtain the Fourier expansions representing all these periodic solutions. All the orbits are found to be stable in the ordinary sense, while the additional "λ-ϖ stability" (Rabe 1962) of the satellite's perigee motion exists only for librations with amplitudes up to those associated approximately with the emergence of four points of minimum velicity, or only for orbits of "simple" shape. Author

N63-15276 California U., La Jolla

RADIOCARBON CONTENT AND TERRESTRIAL AGE OF TWELVE STONY METEORITES AND ONE IRON METEORITE

H. E. Suess and H. Wanke Repr. from Geochimica et Cosmochimica Acta, v. 26, 1962 p 475-480 17 refs
(NASA Grant NsG-98-60)

The radiocarbon content of twelve stony meteorites, six with observed time-of-fall and the others finds, and that of an iron, (Aroos), has been determined. The average contemporaneous radiocarbon content of the falls was found to correspond to 48·2 disintegrations/min. A much lower value of 5·4 disintegrations/min was found for the iron. Of the six finds, two were found to be Pleistocene. The average C^{14} content of the finds investigated indicates that terrestrial ages of the order of a thousand years are quite common. Author

N63-15281 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

THE PERTURBATIONS OF A HYPERBOLIC ORBIT BY AN OBLATE PLANET

Carl G. Sauer, Jr. Jan. 15, 1963 12 p 8 refs
(NASA Contract NAS7-100)
(JPL-TR-32-131) OTS: $1.60 ph, $0.80 mf

The perturbations of the hyperbolic orbital elements of a vehicle in the gravitational field of an oblate planet are derived as functions of the initial osculating elements. Assumptions are made that atmospheric drag is absent and that the gravitational potential of the planet may be represented adequately by the principal term and the second harmonic. An example of an earth-escape mission is presented in which a comparison is made between calculated orbital perturbations and results from a numerical integration of the equations of motion. Author

N63-15292 California U., La Jolla

THE COSMIC ABUNDANCES OF THE ELEMENTS Summer Course on Nuclear Geology Varenna, 1960

H. E. Suess Repr. from Comitato Nazionale per L'Energia Nucleare Laboratorio Di Geologia Nucleare Pisa p 28–37 7 refs
(NASA Grant NsG-98-60)

Cosmic abundances of the elements and their isotopic compositions, as found in meteorites, are reviewed. Results indicate that: (1) A more regular trend of the abundance values of the elements as a function of atomic weight can be obtained by correcting the abundance values of the individual elements. (2) The minute traces of the heavy rare gases included in the meteorites represent the only materials showing signs of incomplete mixing. The rest of the materials of which the solar system consists appear completely homogeneous with respect to isotopic composition of the elements, in spite of the fact that they must have developed from several different sources of nucleogenesis. I.v.L.

N63-15297 National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.

FORMATION OF THE SOLAR NEBULA

A. G. W. Cameron Repr. from Icarus, v. 1, no. 4, Jan. 1963 p 339–342 6 refs

J. Gaustad has shown that no pause is to be expected in the free-fall collapse of an interstellar cloud until the hydrogen and helium of the fragments become ionized. It follows that there cannot be significant loss of angular momentum from the fragments during the collapse. The size and mass distribution of the resulting nebular disks formed from the fragments are discussed. Following a discussion of Mestel, it is concluded that two forms of mass distribution are possible, each with dimensions comparable to those of the solar system. Without axial condensation, there is no shear, and binary star formation seems likely. Author

N63-15304 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A PARAMETRIC INVESTIGATION OF THE LUNAR-ORBIT-RENDEZVOUS SCHEME

David F. Thomas and John D. Bird Washington, NASA, Apr. 1963 64 p 2 refs
(NASA TN D-1623) OTS: $1.75

A parametric study of lunar-mission vehicles designed for lunar-orbit-rendezvous and direct lunar missions was made for the purpose of determining the injected weight required for missions performed under various circumstances. Missions were considered which had crew sizes from 2 to 14 men, transported supplies to be deposited on the moon up to 40,000 pounds, circular and elliptic orbits at the moon with maximum altitudes from 50 to 8,000 international nautical miles, and points of entry into lunar orbit at both apolune and perilune. Three fuel combinations were considered. The results of this study indicate that the lunar-orbit-rendezvous mission requires much smaller weights injected to the moon than the direct lunar mission. For the lunar-orbit-rendezvous mission, the lowest lunar-mission-vehicle weights were generally obtained for low-altitude orbits. In the case of elliptic lunar orbits entered at perilune, vehicle weight was relatively insensitive to lunar-orbit altitude. In the cases of circular lunar orbits and elliptic lunar orbits entered at apolune, vehicle weight increased markedly with lunar-orbit altitude. Author

N63-15306 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF LIFT ON SEPARATION DISTANCE AND LOADS FOR AN ABORTING VEHICLE AT MAXIMUM DYNAMIC PRESSURE OF A LUNAR MISSION

Joseph J. Janos and John R. Unangst Washington, NASA, Apr. 1963 26 p 3 refs
(NASA TN D-1775) OTS: $0.75

This investigation considers some of the effects of using lifting trajectories for abort of a lunar mission during the early part of the launch phase. Particular emphasis is placed on determining the effects of lifting abort trajectories on the possibility of a collision of the launch vehicle and spacecraft if abort is initiated at maximum dynamic pressure of the launch trajectory. Abort trajectories are computed with a range of constant values of lift-drag ratio from -1.0 to 1.0 and thrust levels of 83,450 and 151,300 pounds. The results indicate that a zero-lift abort at maximum dynamic pressure could result in a collision shortly after burnout of the abort motor. However, if the abort vehicle has a lift-drag ratio of ± 0.1, positive separation distance from the launch vehicle is maintained. The

maximum loads encountered depend somewhat on the lift-drag ratio and are −14.3g for the low-thrust level and −18.6g for the high-thrust level. Author

N63-15320 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio

RELATIVE MOTION IN THE DOCKING PHASE OF ORBITAL RENDEZVOUS

Donald D. Mueller Dec. 1962 33 p 6 refs
(AMRL-TDR-62-124) OTS: $1.00

The purpose of this report is to analyze the relative motion which exists between an interceptor and target vehicle in the final stages of orbital rendezvous. Four distinct types of nearby parking orbits were defined. It was assumed that a man wearing an extra-vehicular suit and a self-maneuvering unit would exit the interceptor and traverse the remaining distance to the target. Both two-impulse transfers and continuous-thrust, line-of-sight transfers were analyzed. It was found that the direction in which the man should aim himself to make a two-impulse transfer depends only on the time he wishes to consume in the rendezvous and does not depend on the distance to be traveled. Comparisons of fuel consumption for the two-impulse technique and the line-of-sight technique were made and an optimum transfer combining both these techniques was suggested. The results of this study indicate that Coriolis forces and tidal effects cannot be neglected even at the relatively short ranges associated with orbital docking. Author

N63-15321 Armour Research Foundation, Chicago, Ill.

RADIATIVE ENERGY TRANSFER ON ENTRY INTO MARS AND VENUS Quarterly Report No. 4

William O. Davis Mar. 1963 38 p 16 refs
(NASA Contract NASr-65(00))
(ARF-A200-4) OTS: $3.60 ph, $1.34 mf

The emissivity of carbon dioxide in the 2.7 M region has been measured at temperatures from 2000° K to 3500° K, for optical densities less than 5 atm/cm. The high temperatures were obtained by passing a shock wave through the test gas. A total gas pressure of one atm was maintained by varying the carbon dioxide concentration in an inert gas. Emissivities obtained from absorption and emission measurements are in agreement. The results are compared to an approximate method for calculating emissivity, which considers the molecular population concentrated in a single band whose center is temperature dependent. A comparison with previous results suggests that this single-band model will overestimate the peak and underestimate the width of the observed values. The observed and calculated emissivities are in agreement if the intensities of the $(n_1 + 1, n_2, n_3 + 1 \rightarrow n_1, n_2, n_3)$ and $(n_1, n_2 + 2, n_3 + 1 \rightarrow n_1, n_2, n_3)$ transitions are assumed proportional to $(n_1 + 1)(n_3 + 1)$ and $(n_2 + 1)(n_3 + 1)/2$, respectively. The use of this single-band model, which was originally intended to provide a rough prediction of emissivity, indicates that the use of the appropriate terms of the electric dipole expansion is satisfactory for the $(n_1 + 1, n_2, n_3 + 1 \rightarrow n_1, n_2, n_3)$ transition, but is not for the $(n_1, n_2 + 2, n_3 + 1 \rightarrow n_1, n_2, n_3)$ transition. Author

N63-15322 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ORBITS RETURNING FROM THE MOON TO A SPECIFIED GEOGRAPHIC LANDING AREA

Luigi S. Cicolani Washington, NASA, Apr. 1963 47 p 6 refs
(NASA TN D-1652) OTS: $1.25

This paper develops a method of computing approximate trajectories returning from the moon to a fixed landing site. The gravitational field of a spherical earth is assumed to govern orbital motion, and the entry phase of the trajectories is described by a linear relation between entry range and flight time in the atmosphere. Data were computed for trajectories returning to Edwards Air Force Base during the month of February 1966, and an analysis of these data is presented. Author

N63-15435 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

ON COLLISION AND CAPTURE TRAJECTORIES IN THE THREE-BODY PROBLEM (K VOPROSU O TRAEKTORIYAKH STOLKNOVENIYA I ZAKHVATA V ZADACHE TREKH TOCHEK)

V. S. Turskii London, Ministry of Aviation, Jan. 1963 22 p 8 refs
Transl. by J. W. Palmer from Soobshch. Gos. Astron. Inst. (Moscow), no. 114, 1961 p 13–32
(RAE Library Translation 1024)

The three-body problem of a material point moving within an earth–moon system is examined for collision trajectories, using the Levi–Civita method, where impact occurs on the moon. A canonical system of equations is used, and a solution is derived in the form of an infinite series. Using the first few terms of this series, approximate initial conditions are found which correspond to impact at a predetermined instant of time. Practical calculations using this method were found to be very laborious. The magnitude of the relative selenocentric velocity is determined for the point-body entering the moon's sphere of influence on the first revolution. It is demonstrated that this velocity is considerably greater than the corresponding parabolic velocity. Author

N63-15505 Dudley Observatory, Albany, N.Y.

STUDIES OF MICROMETEORITES OBTAINED FROM A RECOVERABLE SOUNDING ROCKET

C. L. Hemenway (Union Coll.) and R. K. Soberman (Northeastern U.) Repr. from Astron. J., v. 67, no. 5, June 1962 p 256–266 refs
(NASA Grant NsG-155-61; Contract AF 19(604)-5884)
(*Its* Reprint B2)

The "Venus Flytrap" micrometeorite collector rocket was fired from White Sands, New Mexico, on 6 June 1961 at 05:31 a.m. local time. Specially prepared particle impactors were exposed between the altitudes of 88 and 168 km and successfully recovered. The experimental surfaces consisted of 0.24 m^2 of 6-μ-thick Mylar foil for impact and cratering studies and 0.13 m^2 of sealed boxes which were loaded with high-purity materials and surfaces suitable for electron microscopy. Some of these materials were shadowed with aluminum before and after the flight to aid in the discrimination of micrometeorite particles from contaminants. Typical particles and size distributions are shown. Approximately 7 particles/mm^2 were collected during the flight. Most of the particles were submicron in size and generally fell into three types: high-density spheres, medium-density irregular particles, and extremely irregular medium density particles (fluffy particles). Some of the larger particles had sufficient momentum to rupture exposed films. Laboratory and nose-cone control surfaces were carefully studied to permit identification of micrometeorite particles. Preliminary results of chemical composition studies using electron-diffraction, electron-beam probe, and neutron-activation techniques are presented. Author

N63-15506 California U., Berkeley. Space Sciences Lab.

STRUCTURE OF THE LOWER ATMOSPHERE OF VENUS

Carl Sagan Repr. from Icarus, v. 1, no. 2, Sept. 1962 p 151–160 44 refs
(NASA Grant NsG-126-61)

If the centimeter microwave emission from Venus arises from its surface, the radar reflectivities and microwave brightness temperatures give mean darkside-surface temperatures of about 640° K. Extrapolations of the phase data to small phase angles indicate mean brightside-surface temperatures of about 750° K. If the cloudtop pressures and temperatures are known in both hemispheres, the surface pressures and darkside subadiabatic indices can be derived. A reanalysis of the CO_2 absorption bands near 0.8 and 1.6μ and of the Regulus occultation data indicates: (1) that the same cloud level, at $T_c \simeq 234°$ K, is responsible for the reflection and emission throughout the visible and infrared, and (2) that the brightside cloudtop pressure is at least as great as the darkside cloudtop pressure, the most probable values being 0.6 atm and 90 mb, respectively. Even with a small phase effect these cloudtop

pressures give surface pressures ≃50 atm. The darkside lapse rates are substantially subadiabatic, in contradiction to the Aeolosphere Model. Failure of the Urey equilibrium on Venus results in surface pressures of this order or greater; and similar values are obtained from the atmospheric structure deduced from Spinrad's measurements of the near infrared CO_2 band at 7820 Å. The altitude of the cloudtops on the dark side is then ≃80 km, and is possibly even higher in the bright hemisphere. The surface pressures and phase effect lead to a sidereal period of rotation which exceeds 170 days, and is quite possibly equal to the period of revolution. For nonsynchronous rotation, the specific heat capacity of the atmosphere controls the nocturnal cooling. There is a smaller contribution from subsurface conduction. For synchronous rotation, the atmospheric circulation must supply the radiation emitted to space from the dark hemisphere. The effect of Rayleigh scattering on a cloudless day on Venus is to yellow the sky and redden the sun. The radiation scattered back to space will also have a yellow cast, and may explain the apparent color of Venus. The color index should therefore be a function of phase. In short visual wavelengths, the surface of Venus cannot be seen from space, even on a cloudless day. The observations of permanent dark markings at these wavelengths possibly represent clouds connected with surface features far below; they cannot be the surface features themselves. But near infrared photography has the promise of detecting surface markings on Venus. The high surface temperatures and pressures lead to melting and vaporization of surface material, and to greatly enhanced infrared opacities, facilitating the operation of the Greenhouse Effect on Venus. Direct exploration of the surface of Venus would seem to be a very difficult engineering problem. Author

N63-15630 Aerospace Corp., El Segundo, Calif.

OPTIMAL THRUST PROGRAMMING FOR MINIMAL FUEL MIDCOURSE GUIDANCE

James S. Meditch *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio Proc. of the Optimum System Synthesis Conf., 11–13 Sept. 1962 p 55–68 10 refs (See N63-15626 12-01)

The problem of specifying the minimal-fuel thrust program for guiding a space vehicle in its midcourse phase is formulated as an optimization problem. The task of the thrust program is to transfer the vehicle from a given initial-error state (position and velocity) to a terminal-error state of zero with minimum fuel subject to a magnitude constraint on the thrust vector. The form of the optimal thrust program is derived and shown to be of an "on-off" nature with time-varying direction during periods of thrusting. The problem of synthesizing the optimal thrust program is reduced to the problem of maximizing a particular function whose gradient is readily computed. An iterative computational procedure for synthesizing the optimal thrust program is then developed utilizing the method of steepest ascent. Author

30 SPACE VEHICLES

Includes: launch vehicle—spacecraft combinations; operating problems; and stability and control.

For manned space capsules, satellites, and space probes see: 32 Space Vehicles (Spacecraft).

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For related information see: 04 Aircraft; 08 Communication; and 22 Navigation and Guidance.

N63-15302 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THEORETICAL STABILITY ANALYSIS OF SKID-ROCKET LANDINGS OF SPACE VEHICLES

Robert W. Frahlich and Edwin T. Kruszewski Washington, NASA, Apr. 1963 19 p 2 refs
(NASA TN D-1625) OTS: $0.50

The governing equations for an arbitrary rigid body sliding on a landing surface are used to derive a stability criterion which relates the critical values of initial velocities to the coefficient of friction, center-of-gravity location, and initial angle-of-contact. A numerical application of the stability criterion is made for a vehicle used in an experimental investigation. Author

N63-15305 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INVESTIGATION OF THE SKID-ROCKER LANDING CHARACTERISTICS OF SPACECRAFT MODELS

Sandy M. Stubbs Washington, NASA, Apr. 1963 39 p 3 refs
(NASA TN D-1624) OTS: $1.00

An experimental investigation was made of the skid-rocker landing characteristics of two dynamic models of proposed reentry vehicles. A "belly-landing" technique in which the vehicle was caused to skid and rock on its curved lower surface (heat shield) in order to convert sinking-speed energy into angular energy was investigated on a hard-surface runway for speed ranges that might be encountered with the use of a paraglider letdown system. Several landings were also made in calm water. Landing motions and acceleration data were obtained over a range of landing attitudes, horizontal velocities, and vertical velocities. Turnover stability limits for various center-of-gravity locations were determined for hard-surface landings. A brief experimental study was made of the effect of a small edge-mounted shock absorber on accelerations and rocking motions. Acceptable hard-surface landings could be made with all the configurations at landing attitudes between −30° and 10°. For bodies of short length and high center of gravity, the possibility of converting sinking-speed energy into angular energy was substantially limited because of the instability (turnover) at landing attitudes greater than 10°. The landings resulted in maximum normal and angular accelerations of 15g and 70 radians per second^2, respectively, over a range of landing conditions. Water landings were satisfactory at horizontal landing velocities of 50 and 80 feet per second. Landings at 130 feet per second resulted in violent rebound at first impact followed by random impacts and high accelerations. Author

N63-15347 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

CALCULATED RESULTS FOR THE TRANSIENT HEATING AND MELTING PROCESS OF GLASS SHIELDS WITH VARIOUS MATERIAL PROPERTIES AT THE STAGNATION POINT OF A RE-ENTERING ICBM

John D. Warmbrod Washington, NASA, May 1963 28 p 12 refs
(NASA TN D-1643) OTS: $0.75

The transient performance in the vicinity of the stagnation point of ablation-type, glass, heat-protection shields is presented for an ICBM that experienced high, instantaneous ablation rates while reentering the atmosphere of the earth. The vehicle had a ballistic factor of 1000 lb/ft^2 and reentered at a speed of 7226 m/sec, at an altitude of 150 km, and at an angle of 114° measured from the vertical. By the use of an exact numerical calculation method, transient ablation results for 26 hypothetical glass shields, each with a different set of thermal properties, are presented. The effect that the material properties of glass have on the performance parameters of the heat shields was investigated. It was found that the following trend of the glass thermal properties would tend to provide the lightest glass heat-protection shield for the vehicle: (1) a small thermal diffusivity $k/\gamma c_p$, (2) a high viscosity level, i.e., a large resistance to melting, and (3) a large emissivity constant of the supposedly opaque glass. It was found that the vaporization of the glass had very little effect on the necessary weight of the ablation-type shields. Author

N63-15473 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

STUDY OF INERTIAL NAVIGATION ERRORS DURING REENTRY TO THE EARTH'S ATMOSPHERE

Q. Marion Hansen, John S. White, and Albert Y. K. Pang. Washington, NASA, May 1963. 53 p. 8 refs.

(NASA TN D-1772) OTS: $1.50

The navigation errors in position and velocity which result from erroneous initial conditions and imperfect inertial-navigation equipment have been analyzed for a space vehicle reentering the earth's atmosphere. The analysis has shown that, for realistic errors and reentry conditions, a linear error analysis will usually be valid; that is, the partial derivatives of final position and velocity with respect to initial conditions and equipment parameters may be treated as constants. Also, the analysis has demonstrated that these partial derivatives can be used to estimate the final errors which result from using various combinations of initial condition and equipment errors with the inertial navigation process started at various times before reentry. It was found that, when the inertial navigation process is started just prior to reentry, the final errors resulting from initial-condition errors predominate, but, when started well before reentry, the final errors resulting from equipment errors predominate. Initial altitude error is the most significant initial-condition error, and accelerometer bias and gyro drift are the most significant equipment errors. The final errors due to accelerometer bias may be greatly reduced by treating the outputs of the accelerometers as zero above the atmosphere. Author

N63-15547 Societé pour L'Étude et la Réalisation d'Engins Balistiques, Courbevoie (France)

STABILITY ANALYSIS OF THE CONTROL SYSTEM OF LIQUID-PROPELLED MISSILES

P. Polack. Paris, Eurospace [1961] 11 p. Presented at the British Interplanetary Soc. Conf., June 1961

(Rept. 2/1963)

The stability analysis of the overall control system of a liquid-propelled missile involves a transfer function which can be obtained from four simpler types of transfer functions: (1) transfer function of sensing devices, (2) transfer function associated with the intended control law, (3) transfer function of the actuating device, and (4) transfer function of the missile, i.e., the set of relationship between the missile displacement and the applied forces. Obtaining this last function is simple when the associated system can be reduced to a rigid body. If, however, the system to be analyzed consists of a flexible structure with tanks containing fluids, obtaining the transfer function is more complex. A calculation method is proposed that permits the use of digital programs in which the mass, inertia, elasticity, and geometry characteristics of the missile are introduced. The advantages of the method as compared with conventional calculation methods stem from the fact that it applies to any shape of tank and that obstacles and viscosity can be introduced. Each case of calculation requires about 15 minutes operation of an IBM 7090. Author

N63-15635 Raytheon Co. Missile and Space Div., Bedford, Mass.

SORTIE BOOST AND GLIDE TRAJECTORIES DETERMINED FOR SPECIFIED MISSION REQUIREMENTS BY THE STEEPEST-ASCENT TECHNIQUE

Kinya Mikami, C. Tucker Battle, Ralph S. Goodell, and Arthur E. Bryson *In* Aeronautical Systems Div. Flight Control Lab., Wright-Patterson AFB, Ohio. Proc. of the Optimum System Synthesis Conf., 11–13 Sept. 1962. p 189–239. 12 refs. (See N63-15626 12-01)

(AF 33(616)-8300)

A three-dimensional trajectory-optimization computer program is described for determining vehicle performance boundaries. Simultaneous programs for angle-of-attack and bank-angle, with specified initial and terminal conditions, are determined by this program using steepest-ascent computational procedures. Terminal constraints, in the form of upper bounds on total stagnation-point heat absorption and total acceleration dose, and in-flight constraints, in the form of upper bounds on altitude and stagnation-point heating rate, are also included. The vehicle is treated as a mass particle and the earth is approximated as an oblate-spheroid with an ARDC atmosphere rotating with the earth. Only coordinated turn maneuvers are considered. The terminal functions which can be optimized include all the state variables individually and a number of functions of the state variables. These computer programs are specifically oriented for computations on the IBM 7090. A numerical example is given for a Sortie configuration. Three separate but related performance boundaries were computed for this configuration: (1) the boost boundary for the three-stage booster system, (2) Sortie reentry and glide, (3) Sortie lateral maneuvers in the recovery area. Author

N63-15757 Radio Corp. of America. Missile and Surface Radar Div., Moorestown, N.J.

DOWN-RANGE ANTI-MISSILE MEASUREMENT PROGRAM (DAMP): GENERALIZATION OF THE OSCILLATION WAKE ANALYSIS

S. L. Zeiberg (Gen. Appl. Sci. Labs., Inc.) Dec. 1962. 52 p. 15 refs.

(Contract DA-36-034-ORD-3144RD; ARPA Order 51; Proj. Defender)

(DAMP Tech. Monograph 62-27)

The far wake behind a constant velocity, oscillating reentry vehicle is analyzed. The flow is assumed to be laminar and axisymmetric; time-wise drag variations due to vehicle oscillations are represented as unsteady conditions at the initial wake station. The variations of atmospheric density with time (due to descent of the vehicle) and streamwise position in the wake are included. The flow is first analyzed from a general viewpoint; detailed analysis is performed for an integral-method formulation of the problem. Numerical results are presented for oscillating and nonoscillating blunt-body wakes in thermodynamic equilibrium. The latter are compared to steady-state calculations at constant altitude (i.e., constant atmospheric density). Author

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes: boosters; clustered rockets; and multistage rockets.

For propulsion engines see: 27 Propulsion.

For launch vehicle - spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-15525 Congress. House. Committee on Sciences and Astronautics

CENTAUR LAUNCH VEHICLE DEVELOPMENT PROGRAM Report of the Committee on Science and Astronautics, U.S. House of Representatives, Serial Q

George P. Miller et al. Washington, GPO, 1962. 23 p.

(87th Cong., 2nd Sess. H. R. 1959 Committee Print)

This congressional report includes: (1) a discussion of the importance of the Centaur launch vehicle development program, (2) a description of the Centaur launch vehicle, (3) the background and present status of the program, and (4) a discussion of the program delays. I.v.L.

N63-15694 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF SEVERAL FIFTH-STAGE SCOUT REENTRY VEHICLES FROM MACH NUMBER 0.60 TO 24.4 INCLUDING SOME REYNOLDS NUMBER EFFECTS ON STABILITY AT HYPERSONIC SPEEDS

Patrick J. Johnston. Washington, NASA, May 1963. 66 p. 8 refs. (NASA TN D-1638) OTS: $1.75

Longitudinal static stability investigations of several proposed configurations of the fifth-stage Scout reentry vehicle have been conducted in the the Mach number interval from 0.60 to 24.4. The results were summarized to show the effect of varying Mach number on the normal-force-curve slope and zero-lift center of pressure. The effect on longitudinal stability of limited variations in nose shape as well as afterbody geometry were determined at a Mach number of 6.8. The low-angle-of-attack stability of one configuration was examined to determine whether the test results obtained in helium were representative of those obtained in air at Mach numbers near 20. Of the three parameters investigated (Mach number, Reynolds number, and specific heat ratio of the test medium), it appeared that Reynolds numbers had the greatest effect on longitudinal stability at low angles-of-attack. Author

32 SPACE VEHICLES (SPACECRAFT)

Includes: manned space capsules; satellites; and space probes.

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For Launch vehicle—spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-15311 Space Technology Labs., Inc., Redondo Beach, Calif.

OBSERVATIONS OF LOW-FREQUENCY HYDROMAGNETIC WAVES IN THE DISTANT GEOMAGNETIC FIELD: EXPLORER VI

Darrell L. Judge and Paul J. Coleman, Jr. (NASA. Washington, D.C.) July 3, 1962. 57 p. 46 refs.
OTS: $5.60 ph, $1.91 mf

Certain of the measurements obtained simultaneously with three of the instruments aboard the earth satellite, Explorer VI, are discussed. The results from these instruments, the magnetometer, "aspect indicator," and scintillation detector, provide direct evidence for the existence of low-frequency hydromagnetic fluctuations in the distant geomagnetic field as well as some information pertaining to their specific characteristics. The observed phenomena consist of variations in the amplitude and direction of the measured component of the magnetic field accompanied by substantial changes in the intensity of the energetic particles detected by the scintillation counter. The fluctuations exhibited periods between 100 and 500 seconds. Within this range of periods, variations of the order of 10γ ($\Delta B/B \simeq .15$) in amplitude and 15° in orientation were observed in the measured component of the field. These field changes were accompanied by fluctuations of about the same relative amplitudes ($\Delta I/I \simeq .15$) in the intensity of the detected particles. Of particular interest is an observation of damped, quasi-sinusoidal oscillations detected simultaneously by all three instruments. As a basis for the interpretation of these results, simple models for hydromagnetic disturbances propagating in the transverse, or Alfvén, mode and in the compressional mode are described. The experimental results are compared with those which might be expected in the event that the observed distrubances behaved as suggested by the models. Author

N63-15412 Space Technology Labs., Inc. Physical Electronics Lab., Redondo Beach, Calif.

IONIZATION ASSOCIATED WITH HYPERVELOCITY IMPACT

J. F. Friichtenicht and J. C. Slattery. Mar. 14, 1963. 21 p. 3 refs. Presented at the 6th Hypervelocity Impact Symp., Cleveland, Apr. 30–May 2, 1963
(NASA Contract NASw-561)
(Rept. 8699-6002-RU-000) OTS: $2.60 ph, $0.83 mf

Interest in the development of micrometeoroid detection systems has led to a program of research in which efforts have been concentrated on phenomena associated with hypervelocity impact having properties applicable to such systems. It has been found that electrically charged particles are emitted from the site of a hypervelocity impact. The quantity of charge emitted from semi-infinite targets as a function of target material, projectile material, and particle velocity and mass was measured. The experiments were conducted with micron-sized iron and carbon black (graphite) particles from the electrostatic hypervelocity accelerator. Data were collected for velocities up to 16 km/sec. All of the data fits the empirical relationship $Q_c = K E_p (v/A)$, where Q_c is the charge collected, K a constant, E_p the particle energy, A the atomic weight of the particle material, and v the particle velocity. Qualitative observations of ionization produced from thin-foil impacts have also been made. Author

N63-15415 Atomics International, Canoga Park, Calif.

SURVEY OF METEOROID PROPERTY AND DISTRIBUTION DATA RELEVANT TO SNAP 8 REACTOR AND SHIELD DESIGN

C. R. Harder. Apr. 30, 1963. 41 p. 33 refs.
(Contract AT(11-1)-GEN-8)
(NAA-SR-8127) OTS: $0.75

This report is a survey of existing literature relative to the properties and distributions of meteoroids. Its object is to predict the criteria which may be used to calculate the imparing effect of this meteoroidal phenomenon on the SNAP 8 space system and/or its components and other space-vehicle structures. Author

N63-15430 Congress. House. Committee on Science and Astronautics

PROJECT ANNA— GEODETIC SATELLITE SYSTEM. Report of the Committee on Science and Astronautics, U.S. House of Representatives

George P. Miller. Washington, GPO, 1962. 13 p.
(87th Cong., 2nd. Sess. H.R. 2151 Committee Print)

A survey of the ANNA satellite is presented. This satellite contains three different types of instrumentation. Each type provides a distinct technique for developing worldwide geodetic control. The optical technique will make use of a flashing light contained in the satellite. The radio ranging technique makes use of an apparatus designated by the acronym Secor (sequential collation of range). The radio Doppler technique utilizes a satellite transmitter whose frequency is controlled by a very stable quartz crystal oscillator. These three techniques produce three basically different types of data—angle, range, and range rate. Project ANNA is a useful first step in the development of a geodetic satellite system; however, it was not conceived to do a complete job in geodesy. The ANNA satellite was intended as a device to be used for the calibration of instrumentation at the various U.S. tracking stations around the world. Although it will probably produce some very valuable geodetic data, a truly effective program must include a number of satellites at different altitudes and inclinations. I.v.L.

N63-15454 Baja Inst. of Astronomy (Hungary)

BAHNBESTIMMUNG VON KUNSTLICHEN ERDSATELLITEN AUF GRUND VISUELLER BEOBACHTUNGEN [TRACK DETERMINATION OF ARTIFICIAL EARTH SATELLITES ON THE BASIS OF VISUAL OBSERVATIONS]

M. Ill. Apr. 1962. 17 p. 10 refs. In German; English summary
(*Uts* Bulletin no. 1)

A method is given for determination of radii vectors of artificial satellites from simultaneous observations of two satellite-tracking stations. The orbital elements of an artificial satellite can be calculated from at least two radii vectors. In the course of series processing, the calculations can be simplified by use of tables and monograms. Author

N63-15504 Congress. Senate. Committee on Commerce
SATELLITE COMMUNICATIONS Hearings before the Subcommittee on Communications of the Committee on Commerce, U.S. Senate, Feb. 18, 19, and 27, 1963
Hugh L. Dryden et al Washington, GPO, 1963 99 p
(88th Cong. 1st Sess. Serial 3)

Representatives from NASA, FCC, Bell Telephone Laboratories, and RCA depict progress and development in the operations of the experimental communications satellites with emphasis on Telstar and Relay operations. Also, documents were presented to the subcommittee on the following: NASA budget; NASA news release on Syncom project; Satellite situation report; portion of public hearings on Patent Waiver Regulations; list of companies applying to FCC for voting stock in the Communications Satellite Corporation; and FCC authorization for a line of credit for this corporation. R.C.M.

N63-15516 Weather Bureau. Meteorological Satellite Lab., Washington, D.C.
CONFERENCE ON SFERICS MEASUREMENTS FROM SATELLITES, WASHINGTON, D.C., APRIL 27, 1962
Stanley D. Soules, ed. Oct. 1962 54 p
(Meteorol. Satellite Lab. Rept.-13)

This report is a transcript of the Conference on Sferics Measurements from Satellites. The following topics were presented and discussed: (1) Electrical Properties of the Atmosphere, (2) Meteorological Implications, (3) Surface Observations of Sferics, (4) Practical Satellite Measurements, and (5) The Significance of Sferics Data. I.v.L.

N63-15533 Minneapolis-Honeywell Regulator Co., Aeronautical Div., Minn.
AN ATTITUDE CONTROL SYSTEM FOR A MANNED LUNAR VEHICLE
Dwight W. Thompson [1962] 48 p 3 refs

A stabilization and control system for a manned lunar flight is discussed. Two possible choices for a stabilizing logic, which would provide the low-rate limit cycles required during translunar and transearth coast modes, are presented. A solid-state mechanization, functionally similar to the orbit logic used to stabilize the Mercury capsule, is one possibility. The other is based on previous Honeywell aircraft autopilot controls. J.A.J.

N63-15535 National Weather Satellite Center, Washington, D.C.
CATALOGUE OF TIROS V CLOUD PHOTOGRAPHY FOR AUGUST 1962 (Passes 608 thru 1055)
October 1962 48 p
(*Its* Catalogue Preprint 3)

The weather maps presented are made from Tiros V cloud photographs for August 1962 and cover all geographical areas of the earth from latitude 60° north to 60° south. R.C.M.

N63-15554 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE PRELIMINARY ORBITAL ELEMENTS OF THE CABIN (1960 ϵ_3) OF THE FOURTH SOVIET ARTIFICIAL EARTH SATELLITE (PREDVARITEL'NYE ELEMENTY ORBITY KABINY (1960 ϵ_3) IV SOVETSKOGO ISKUSSTVENNOGO SPUTNIKI ZEMLI)
G. A. Chebotarev and E. N. Makarova London, Ministry of Aviation, Mar. 1963 5 p 1 ref Transl. by J. W. Palmer from Byul. St. Optich. Nablyudeniya Iskusstv. Sputnikov Zemli, 1962 p 11–13
(RAE Library Translation 1029)

The orbit of Sputnik 4 cabin (1960 ϵ_3) is determined from 3000 observations in the time interval October to December 1961. A table of orbital elements is given. Author

N63-15570 RAND Corp., Santa Monica, Calif.
SOVIET ASTRONAUTICS: 1957—1962
F. J. Krieger Apr. 1963 21 p Presented at the Annual AF Space Briefings for the State Dept. Seminar in For. Policy, Patrick AFB, Fla., Mar. 6–8, 1963
(RM-3595-PR)

The Soviet aerospace program has been developing in four well-defined, although interrelated phases—the Earth-orbital, the lunar, the interplanetary, and the ancillary or so-called Cosmos Series—with corresponding increase in technological complexity. All phases are aimed at eventual manned interplanetary travel. The current Earth-orbital, or man-in-space, program has received the greatest emphasis, and has been the most successful. The interplanetary phase, despite single probes to Venus and Mars, has been plagued with difficulties in effecting the transfer from a parking orbit to an interplanetary trajectory. Author

N63-15619 Weather Bureau. Meteorological Satellite Lab., Washington, D.C.
KEY TO METEOROLOGICAL RECORDS DOCUMENTATION NO. 5.33. CATALOGUE OF METEOROLOGICAL SATELLITE DATA—TIROS III TELEVISION CLOUD PHOTOGRAPHY
Robert L. Pyle and Leslie A. Watson Washington, GPO, 1962 147 p 3 refs
GPO: $0.70

Tiros III, launched by NASA on July 12, 1961, traveled in a nearly circular orbit that averaged about 410 nautical miles above the Earth's surface. The orbital period of 100.4 minutes corresponded to over 14 passes around the Earth each day. The satellite spun at a rate which varied from 8 to 10 r.p.m. Pictures were obtained in a zone bounded roughly by 55° N and 55° S in latitude. Two wide-angle-lens cameras were carried on Tiros III. Areas of 750 miles square were photographed when the optical axis was normal to the Earth's surface. J.A.J.

N63-15653 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio
RELATIVE MOTION IN THE DOCKING PHASE OF ORBITAL RENDEZVOUS [Final Report, Dec. 1961– Mar. 1962]
Donald D. Mueller Dec. 1962 33 p 6 refs
(AMRL-TDR-62-124) OTS: $1.00

The purpose of this report is to analyze the relative motion which exists between an interceptor and target vehicle in the final stages of orbital rendezvous. Four distinct types of nearby parking orbits were defined. It was assumed that a man wearing an extravehicular suit and a self-maneuvering unit would exit the interceptor distance to the target. Both two-impulse transfers and continuous-thrust, line-of-sight transfers were analyzed. It was found that the direction in which the man should aim himself to make a two-impulse transfer depends only on the time he wishes to consume in the rendezvous and does not depend on the distance to be traveled. Comparisons of fuel consumption for the two-impulse technique and the line-of-sight technique were made, and an optimum transfer combining both these techniques was suggested. The results of this study indicate that Coriolis forces and tidal effects cannot be neglected even at the relatively short ranges associated with orbital docking. Author

N63-15734 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
A PEGASUS COMPUTER PROGRAMME FOR THE PREPARATION OF EPHEMERIDES OF AN EARTH-SATELLITE
R. J. Tayler London, Ministry of Aviation, Dec. 1962 22 p 7 refs
(RAE-TN-SPACE-23)

Merson's dynamical model of the motion of an earth-satellite is used to obtain the geocentric polar coordinates of a satellite at a given time. Formulae for obtaining the geographic coordinates of the subsatellite point and for determining six special points on each orbit are presented. Author

33 STRESSES AND LOADS

Includes: fatigue; vibration; flutter; and structural tests.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 34 Structural Design.

N63-15247 California Inst. of Tech. Graduate Aeronautical Labs., Pasadena

FINITE ELASTIC SLUMP OF AN INFINITELY LONG HOLLOW CYLINDRICAL INCOMPRESSIBLE NEO-HOOKEAN BODY BONDED TO A RIGID OUTER TUBE

P. J. Blatz Dec. 1962 5 p

(NASA Grant NsG-172-60, Suppl. 1-62)

(GALCIT-SM-62-54) OTS: $1.10 ph, $0.80 mf

The existence of a large second-order effect in the finite elastic slump of an infinitely long, hollow, cylindrical, incompressible, neo-Hookian body bonded to a rigid outer tube is demonstrated. This second-order normal stress effect is not accounted for by the linear elastic solution of the slump problem. Furthermore, although second-order in the analytic sense, it may be larger than the first-order shear component under certain conditions. The physical significance of this positive definite component in predicting failure of rubbers and of rockets subjected to g forces is indicated. M.P.G.

N63-15260 Southwest Research Inst., San Antonio, Tex.

LONGITUDINAL FORCED VIBRATION OF PARTIALLY FILLED TANKS Technical Report No. 6

Daniel D. Kana Feb. 28, 1963 41 p 18 refs

(NASA Contract NASw-146; SwRI Proj. 4-961-2)

OTS: $4.60 ph, $1.43 mf

This report presents the results of a study of the longitudinal forced vibration of tanks containing liquids of arbitrary depth, and includes some of the most significant individual aspects that occur throughout a wide range of excitation frequencies. Three basic areas are involved—the liquid system, the tank system, and the coupled liquid-tank system. Liquid surface resonance, capillary wave behavior, and bubble behavior and cavitation in a rigid tank are considered. These areas are again discussed as they occur for the elastic tank, along with the behavior of the liquid–elastic tank system. The occurrence of subharmonic tank breathing modes, and the production of low-frequency liquid-surface resonances by high-frequency tank-breathing motion are noted and attributed to instabilities occurring in the coupled liquid–elastic tank system. In general, it is found that the overall problem involves various areas in which only a nonlinear analysis is feasible even to obtain qualitative information. Unfortunately, the usual difficulties of a nonlinear approach are even magnified here because of the coupling between two complex systems. Author

N63-15267 Bettis Atomic Power Lab., Westinghouse Electric Corp., Pittsburgh, Pa.

A VERIFICATION OF METHODS FOR ANALYZING STRESSES AND DEFLECTIONS IN PERFORATED MATERIALS AND AN EVALUATION OF ROLLED-IN TUBE EFFECTS

W. J. O'Donnell (Ph. D. Thesis–U. of Pittsburgh) *In its* Bettis Technical Review Reactor Technology Mar. 1963 p 61–76 3 refs

(See N63-15261 12-10) OTS: $2.00

A perforated steel beam with a triangular penetration pattern was subjected to uniaxial tension, compression, and bending loads. Measured deflections and ligament strains agreed very satisfactorily with results calculated by using recently developed analytical methods. Beams with rolled-in tubes were also tested, and the calculated results agreed with the measured results when one-half of the tube wall was assumed to act as an integral part of the perforated material. Author

N63-15325 Columbia U., New York, N.Y.

SOME PROBLEMS IN PHENOMENOLOGICAL FRACTURE MECHANICS Technical Documentary Report [Mar. 1961–Mar. 1962]

A. M. Freudenthal and M. P. Bieniek Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1963 25 p 7 refs

(Contract AF 33(616)-6112)

(ASD-TDR-63-221)

This report deals with certain problems of propagation of microcracks (Griffith cracks) and fracture cracks. The phenomenological approach based on the concept of the continuum and the methods of mechanics of solids is used. An energy criterion for equilibrium of cracks in inelastic solids is formulated in a form that reduces to Griffith's criterion in the case of brittle solids. Griffith's criterion is simplified to obtain Orowan's criterion for elastic-plastic solids. Another criterion is derived from the analysis of the stresses at the edge of a crack. This stress criterion is also extended over time-dependent crack resistance by relating it to certain characteristics of the inelastic deformation. Author

N63-15332 Lehigh U. Fritz Engineering Lab., Bethlehem, Pa.

PLASTIC DESIGN IN HIGH STRENGTH STEEL. THE EXPERIMENTAL BASIS FOR PLASTIC DESIGN–A SURVEY OF THE LITERATURE

M. G. Lay Mar. 1963 42 p 185 refs

(Contract Nonr-610(03))

(Fritz Engineering Lab. Rept. 297.3)

A bibliography of structural tests is presented which covers tests that form the basis of the plastic method of design. The discrepancies between the test result and the theoretical prediction are given for each test. A general conclusion drawn is that plastic can be a valid and effective method when used within the bounds assigned by the standard texts. R.C.M.

N63-15333 Syracuse U. Research Inst., N.Y.

THE EFFECT OF STRESS GRADIENT AND STRESS BIAXIALITY ON THE BEHAVIOR OF MATERIALS [Final Report, Oct. 15, 1960–Oct. 15, 1961]

Volker Weiss, John Sessler, and Kushwant Grewal Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, May 1962 74 p 13 refs

(Contract AF 33(616)-7609)

(ASD-TR-61-725)

The effects of stress gradient and stress biaxiality on the notch strength of brittle, semibrittle and semiductile materials were investigated. The experimental results obtained on a nearly ideally brittle titanium alloy are in agreement with the predictions of a fracture concept based on Neuber's theory of notch stresses. Accordingly, the stress-concentration factor is the dominant parameter which affects the notch strength. The magnitude of the stress gradient and stress biaxiality at the notch root has a secondary effect in that the notch strength of brittle materials is reduced with decreasing gradient and increasing biaxiality. The notch strength behavior of brittle ceramics has to be interpreted in terms of the inhomogeneity of these materials. Weibull's statistical theory of fracture was applied to this problem. Author

N63-15438 Armour Research Foundation, Chicago, Ill.

INVESTIGATION OF GLASS FIBER STRENGTH ENHANCEMENT THROUGH BUNDLE DRAWING Final Report, Jan. 6, 1961–Apr. 6, 1962

N. A. Weil, J. S. Islinger, and D. W. Levinson May 1962 106 p 71 refs

(Contract NOw-61-0259-C)

(K-213)

A theoretical review and new analytical derivations are presented which give a reasonably detailed coverage of the state-of-the-art concerning strength theories for glasses, experimental

evidence of the strength/size relationship in glass fibers, and a newly completed analysis predicting the interrelationships between variables for glass fibers drawn from rods. The theoretical analysis shows that there is a very real limitation of fiber size such that no fibers below a certain diameter can be drawn in monofilament drawing operations. This clearly indicates that ultrafine diameter fibers may be obtained only by the bundle-drawing process. The feasibility of the bundle-drawing process in producing very fine glass filaments within the bundle-drawn fibers has been shown experimentally. Protective metallic-coating techniques have been developed but require further work before the method becomes capable of producing discrete ultrafine fibers with enhanced strength characteristics. Author

N63-15498 New Mexico U. Engineering Experiment Station, Albuquerque
STRESS DISTRIBUTION DUE TO A LOGARITHMIC SPIRAL DISLOCATION
F. D. Ju Jan. 31, 1962 63 p 13 refs
(Contract AF 49(638)-993)
(ME-3; AFOSR-904)

The problem of the logarithmic spiral dislocation cut has been solved and results compared with experimental findings. The stress pattern about the inner circumference was observed to be symmetrical about a line which passes through the origin of the circular cutout and the terminus of the dislocation cut. This symmetry is unexpected. The maximum shearing stress is found to be finite, contradicting the concept of wedge action in solids. D.E.R.

N63-15623 Sikorsky Aircraft Div., United Aircraft Corp., Stratford, Conn.
THE APPLICATION OF RELIABILITY CONCEPTS TO FATIGUE LOADED HELICOPTER STRUCTURES
Harry T. Jensen [1962] 39 p 23 refs Delivered to 18th Ann. Forum of Am. Helicopter Soc., Washington, May 3, 1962

CONTENTS:

1. A METHOD OF ANALYSIS FOR HELICOPTER COMPONENT STRUCTURAL RELIABILITY C. E. Nord 21 p 23 refs (See N63-15624 12-33)

N63-15624 Sikorsky Aircraft Div., United Aircraft Corp., Stratford, Conn.
A METHOD OF ANALYSIS FOR HELICOPTER COMPONENT STRUCTURAL RELIABILITY
Carl E. Nord *In its* The Application of Reliability Concepts to Fatigue Loaded Helicopter Structures [1962] 21 p 23 refs Delivered to 18th Ann. Forum of Am. Helicopter Soc., Washington, May 3, 1962 (See N63-15623 12-33)

Statistical analysis of a structural component requires assessment of the following factors: (1) the S-N-P relationship for detected initiation of a fatigue crack, where S is the applied Stress, N is the associated number of stress reversals, and P is the probability of crack initiation for the given stress and number of cycles or hours; (2) the S-Δ T-P relationship for propagation of a detected crack to fracture, where S is the applied stress, ΔT is the associated number of cycles or hours from detection to complete fracture for the given stress, and P is the probability of propagation to fracture at the given stress and time interval; (3) the spectrum of flight loading the component encounters in service; (4) the method of inspection and its reliability; and (5) the interaction of the items listed above.
Author

N63-15652 ARA, Inc., West Covina, Calif.
RESEARCH ON ENERGY ABSORBING STRUCTURES Final Report, Feb. 1962- Feb. 1963
Bernard Mazelsky, D. L. Platus, P. J. Cunningham, and F. A. Maravich Feb. 1963 115 p 5 refs
(Contract AF 49(638)-1144)

Theoretical and experimental studies of convoluted-type structures are described. An incremental method for predicting the nonlinear large-deformation behavior of two-dimensional convoluted strips is shown. The method is applicable for elastic as well as plastic stress-strain behavior of the material. The results of the two-dimensional analysis are extended to an analysis of a circumferentially convoluted cylinder which deforms into a conical shape. Tests on typical two- and three-dimensional convoluted metal specimens are described, and correlations of theoretical predictions with experimental results are shown. Author

N63-15679 Vermont U., Burlington
ON THE STRENGTH DEGRADATION OF FILAMENT WOUND PRESSURE VESSELS SUBJECTED TO A HISTORY OF LOADING
John O. Outwater and Willard J. Seibert Apr. 22, 1963 14 p 2 refs
(Contract Nonr-3219(01)(x))
(Tech. Memo. 196)

If it is assumed that the rate of growth of a Griffith crack that controls the strength of a fiber is proportional to a power of the stress on that fiber, it can be predicted that the ultimate strength of a filament-wound pressure vessel decreases linearly with the time at a given load, and also that the time to failure when the vessel is held at a given load will increase logarithmically. Both these observations are confirmed experimentally, and form the basis for a simple method of predicting the life of a vessel at one load after it has been held for a given time at another. Author

N63-15713 Utah., Salt Lake, City
FRACTURE PROCESSES IN GERMANIUM [Final Report, June 1, 1961-Nov. 30, 1962]
O. W. Johnson, N. Farb, and P. Gibbs Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1963 35 p 41 refs
(Contract AF 33(616)-6832)
(ASD-TDR-62-1029)

The fracture strength, δ_F, of germanium, at constant loading rate has been determined over a temperature range from $-196°$ C to 500° C. δ_F decreases slowly up to about 200° C, then increases to about 400° C, followed by subsequent decrease. δ_F is found to be essentially independent of ambient for a wide variety of chemical species. These observations are analyzed in terms of fracture nucleation at a flaw near, but not exposed to, the surface, by a presently unknown kinetic process. The role of dislocations apparently is to inhibit fracture by relaxation of stress concentrations up to about 400° C, above which general plastic deformation precedes fracture, suggesting the possibility of fracture nucleation by dislocation pileups. The applicability of this analysis to another brittle system, Al_2O_3, is considered in the light of its reported fracture, deformation, wear, and friction characteristics. Striking similarities are found in the behavior of these crystals, suggesting that the underlying mechanisms must have much in common. Author

N63-15740 Franc. Office National d'Etudes et de Recherches Aeronauti Chatillon-Sous-Bagneux
DÉTERMINATION PAR ESSAIS DE VIBRATION AU SOL DES CARACTÉRISTIQUES D'UNE STRUCTURE D'AVION NÉCESSAIRE AUX CALCULS DE ≪FLUTTER≫ ET A LA RECHERCHE DES CORRECTIONS EVENTUELLES (DETERMINATION, BY VIBRATION GROUND-TESTS, OF THE AIRPLANE STRUCTURE CHARACTERISTICS NECESSARY FOR FLUTTER CALCULATIONS AND FOR THE DETECTION OF CORRECTIONS, IF ANY)
Robert Mazet and Christian Beatrix April 1963 19 p In French; English Summary
(ONERA-TN-72)

Interest in the natural shape surfaces of the ideal airplane, obtained by elimination of structural damping, is discussed. The main difficulties found during vibration testing of the finished airplane are underlined. The operations leading to the determination of the

generalized mass stiffness and damping are described, as well as the precautions necessary for differentiating two pure modes with very close frequencies. Author

34 STRUCTURAL DESIGN

Includes: structural elements; and weight analysis.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 33 Stresses and Loads.

N63-15330 Lehigh U. Fritz Engineering Lab., Bethlehem, Pa.
WELDED CONTINUOUS FRAMES AND THEIR COMPONENTS. EXPERIMENTS ON BRACED WIDE-FLANGED BEAMS
G. C. Lee, A. T. Ferrara, and T. V. Galambos Mar. 1963 76 p 9 refs (Sponsored jointly by the Navy and the Welding Research Council) (Fritz Engineering Lab. Rept. 205H.6)

This report contains a description of fourteen experiments on wide-flange beams braced by purlins. These experiments were performed to study the bracing requirements of plastically designed beams. All fourteen beams performed in a satisfactory manner by delivering a plastic hinge of sufficient rotation capacity. The results indicate that beam-bracing members need to possess only nominal bending stiffness. Failure in each test was precipitated by combined local and lateral-torsional buckling. Author

N63-15351 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INFLUENCE OF WEIGHT PARAMETERS ON THE PROPULSION REQUIREMENTS OF ORBIT-LAUNCHED VEHICLES
Dietrich W. Fellenz and Ronald J. Harris Washington, NASA, May 1963 91 p 11 refs
(NASA TN D-1525) OTS: $2.25

The effects of thrust-to-weight ratio and structural-weight assumptions on payload performance have been investigated for orbit-launched vehicles with lunar or escape missions. The propulsion systems considered were high-energy chemical and nuclear heat-exchanger systems. It is shown that the assumption of structural weights as being composed of terms proportional to thrust level and propellant loading is necessary and practical for the discussion of the influence of thrust-to-weight ratio on payload performance. Results are given in parametric form showing payload ratio and related performance parameters as functions of thrust-to-weight ratio, representative engine and tankage specific weights for both propulsion systems, tangential and circumferential thrust orientations, and different altitudes. The curves permit the rapid determination of maximum payload conditions as well as the discussion of performance parameters of off-optimum configurations. Author

N63-15390 Northrop Corp. Northrop Space Labs., Hawthorne, Calif.
HYPERVELOCITY PUNCTURING OF SELF-SEALING STRUCTURES Technical Memorandum
Philip J. D'Anna Mar. 1963 29 p 5 refs Presented at the 6th Hypervelocity Impact Symp., Cleveland, Ohio, May 2, 1963
(NASA Contract NASr-102)
(NSL-63-53) OTS: $2.60 ph, $1.07 mf

The concept of self-sealing structures is proposed as a promising and highly reliable technique for minimizing air leakage due to meteoroid-induced punctures to pressurized space-vehicle compartments. Three mechanical and two chemical self-sealing concepts are presented. Details are given on the development of one of the mechanical concepts in which an elastomer is used as the self-sealing constituent. Both panel configuration and elastomer response to hypervelocity puncturing need to be considered in order to obtain a successful self-sealing panel. A correlation is then shown to exist between dynamic elastomer-response characteristics required for successful sealing, and pertinent static and dynamic material properties. It is proposed that the static-material-property correlation be used as a preliminary screening tool for candidate elastomers while dynamic testing, preferably by hypervelocity puncturing, be used for the final evaluation. In conclusion, the air-leakage rate through panels punctured by ⅛-inch-diameter steel spheres at velocities to 7,000 fps were found to vary from zero leakage to 1.4 lbs/day for a driving pressure of 14.7 psi. This compares with a leakage rate of 260 lbs/day for a hole the same diameter as the pellet used in puncturing the self-sealing panels. Author

N63-15393 National Aeronautics and Space Administration. Washington, D.C.
ON ISOMETRIC DEFORMATION OF SCREW SURFACES
G. W. Schindler (Astro Research Corp.) Washington, NASA, May 1963 14 p 3 refs •Previously processed as technical report ARC-R-72; see N63-12656 06-34
(NASA Contract NASr-8) Previously processed as technical report ARC-R-72; see N63-12656 06-34
(NASA TN D-1918) OTS: $0.50

A study of strain-free deformation mechanisms of surfaces that are capable of folding into a flat annular disk of vanishing engulfed volume is presented. The approach used follows a technique of isometric mapping. Author

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